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Annual Reports of the Department of Agriculture for the Year ending 30th June, 1939.—*New Guinea agric. Gaz.* **6** no. 2 pp. 6–19. Rabaul, 1940.

It is stated in the Report of the Director (G. H. Murray) (pp. 6–9) that the introduced toad, *Bufo marinus* [*cf. R.A.E.*, A **28** 607] has become established in the Territory of New Guinea and is successfully controlling several insect pests, including *Hippotion celerio*, L., on sweet potato.

In the Entomologist's Report (pp. 9–13), J. L. Froggatt reviews work in connection with the introduction, breeding and distribution of *Pleurotropis parvulus*, Ferrière, against *Promecotheca papuana*, Csiki, on coconut in New Britain [*cf.* next abstract]. This Eulophid was also introduced into Manus Island. The black palm weevil, *Rhynchophorus papuanus*, Kirsch [*cf.* **25** 451], caused considerable damage to coconut in one area in New Britain. Larvae of *Prodenia litura*, F., and *Heliothis armigera*, Hb. (*obsoleta*, F.) were numerous on taro [*Colocasia*] and maize, respectively, and *Pseudococcus* sp. and *Coccus viridis*, Green, on coffee. Two consignments of copra were so heavily infested by larvae of *Ephestia cautella*, Wlk. [*cf.* **28** 153] that they were fumigated for 48 hours with Cyanogas calcium cyanide at the rate of 3 lb. per 1,000 cu. ft. The Braconid, *Microbracon* (*Bracon*) *hebetor*, Say, was later found breeding in considerable numbers in the larvae of *E. cautella*. A list is given showing the insect pests, parasites and predators that were bred or collected in the Territory during the year.

O'Connor (B. A.). **The Coco-nut Leaf-miner, *Promecotheca papuana*, Csiki, and its Parasites.**—*New Guinea agric. Gaz.* **6** no. 2 pp. 20–30, 4 refs. Rabaul, 1940.

An account is given of observations on Manus Island in 1938 and in New Britain in 1938–39 on the bionomics of *Promecotheca papuana*, Csiki, on coconut [*cf. R.A.E.*, A **24** 466] and on its natural enemies. The most serious outbreaks of this Hispid in recent years have been that at Lindenhafen, in the south of New Britain, in 1936 [**26** 435] and that in the Rabaul district following the volcanic eruption of May 1937 [**28** 49], which is believed to have caused the destruction of its natural enemies.

In field observations, one or more pairs of newly-emerged adults were confined in wire sleeves attached to growing palms so as to contain several leaflets. When the food supply was exhausted or several batches of eggs had been laid, the beetles were removed to fresh leaflets and the development of the eggs and larvae was followed up. In the laboratory, larvae were bred in leaflets in water. There are usually about 3 larvae per mine, but during an outbreak as many as 20–30 egg clusters may be laid on one leaflet, the larval mines may run into one another, and up to 13 larvae have been observed feeding in a single mine. In such cases, however, only a few of them reach maturity. It appears that a female is able to deposit a total of 80–100 eggs at the average rate of 3 per cluster. The egg and larval stages lasted about 2 and 4 weeks, respectively, the period from the beginning of the prepupal stage to the emergence of the adults from the leaves about a fortnight, and the preoviposition period about 1–2 months. The adults survive for up to 5 months, and probably more, and there appear

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to be between 3 and 4 complete generations a year. Although it would be theoretically possible for all stages to be present at one time, this occurred in only one month on New Britain. Besides coconut, *P. papuana* develops on the sago palm (*Metroxylon sagu*). It oviposits on the oil palm (*Elaeis guineënsis*) during severe outbreaks, but the larvae die after feeding for one or two days.

A colony of the Eulophid parasite, *Pleurotropis parvulus*, Ferrière, which was introduced into New Britain from Fiji in September 1938 [**28** 50], was despatched at the end of November from Rabaul to Lindenhafen, where it was bred (by a technique that is described) and distributed. By the end of July 1939 it was firmly established there, and the percentage of mines containing parasitised hosts appeared to be about 7. Two weeks after the initial liberation, parasitised larvae and pupae of *Promecotheca* were found 200 yards from the point of release. The life-cycle of the parasite usually lasted about three weeks, and its threshold of development, calculated from data obtained by keeping parasitised larvae and pupae of *Promecotheca* in a refrigerator, is about 55°F. The eggs are deposited in the larvae, prepupae or pupae of the Hispid through the epidermis on the under-surface of the leaflet. Larvae of the host feed more voraciously after parasitism and may continue to do so for a fortnight, while parasitised prepupae almost invariably reach the pupal stage before dying. The parasite larvae pupate inside their host, and the adults, which are briefly described, escape through holes in the upper epidermis of the leaflet. Super-parasitism was seldom observed in the field but was common in the laboratory when the number of hosts was insufficient. Up to 40 normal adults, however, can develop in a mature larva, prepupa or pupa.

The most important parasite of the larvae of *Promecotheca* in 1937 was *Eurytoma promecothecae*, Ferrière [**28** 50], the adults of which are briefly described. Development from oviposition to adult emergence lasted 17–21 days. In the laboratory, the adults survived for up to 60 days when not provided with hosts, and 35 when allowed to oviposit. This Eurytomid has not been recorded outside New Britain. The Eulophid, *Derostenus* sp., which is common in the Territory, is an internal parasite of the larvae of *Promecotheca* and completes its life-cycle in 18–21 days. The host larvae cease feeding after parasitism, and the parasites pupate in the mine. In the laboratory, *Derostenus* did not oviposit in prepupae or pupae, but pupae parasitised by it were observed in the field. Three females, supplied regularly with food and host larvae, lived 25, 26 and 32 days, respectively, and oviposited until 1–2 days before death. When *Derostenus* and *Pleurotropis parvulus* oviposited in a host larva at the same time, only adults of the former species emerged.

Another Eulophid, *Closterocerus splendens*, Kowalski, and a Eupelmid of the genus *Anastatus* attack the eggs of *Promecotheca* and are the main factors responsible for the break in the overlapping of generations in some districts. On 3rd July 1938, 6 weeks after the beginning of oviposition, the percentage of eggs parasitised had reached 100 at Lindenhafen. *C. splendens* completed its life-cycle in about 21 days, and only one parasite developed in a single egg.

All stages of *P. papuana* are destroyed by ants, a list of which is given and of which *Pheidole megacephala*, F., was the most important. *Oecophylla smaragdina virescens*, F., however, even when present in large numbers, was not observed to attack eggs, larvae or pupae of

the Hispid [*cf.* **26** 435, 495], though it sometimes carried off the adults to its nests. Larvae of the Hispid are sometimes killed by a bacterial disease, and many of the adults are destroyed by the fungus, *Synnematium jonesii*, during the period of heavy rains in the Lindenhafen district, which lasts from April to October, but the control afforded by these diseases appears to be of no economic importance.

O'Connor (B. A.). **Notes on the Coco-nut Leaf Hispa, *Brontispa froggatti*, Sharp, and its Parasites.**—*New Guinea agric. Gaz.* **6** no. 2 pp. 36–40, 3 refs. Rabaul, 1940.

An account is given of observations on the bionomics of the Hispid, *Brontispa longissima*, Gestro (*froggatti*, Sharp) on coconut [*cf. R.A.E.*, A **24** 467], carried out in 1939–40 in the district of Rabaul in New Britain, where the mean daily temperature is 80°F. All stages are briefly described. In the laboratory, the egg, larval and pupal stages lasted 5, 30–40 and 6 days, respectively, and the shortest preoviposition period observed was 23 days. It appeared, however, that over ten weeks elapse between adult emergence and the middle of the oviposition period, which suggests that there are three generations a year. The eggs are laid in batches of 1–4 between or inside the tightly folded leaflets, and the larvae and adults feed among the unopened leaflets. The adults are probably the more injurious, as they live longer than the larvae. Other palms known to be attacked by this Hispid are *Metroxylon sagu*, *Areca catechu*, *Washingtonia filifera*, *Oreodoxa regia*, *Elaeis guineënsis* and *Thrinax parviflora*.

Native parasites comprise a Trichogrammatid that attacks a considerable proportion of the eggs and a Eulophid that parasitises the larvae but is comparatively rare. In August 1939, a consignment of *Tetrastichus* (*Tetrastichodes*) *brontispae*, Ferrière, was received at Rabaul from the British Solomon Islands, where it had been imported against *B. longissima*, but had not been successful [*cf.* **25** 347]. This Eulophid was bred in pupae of *B. longissima* in glass tubes, and development was completed in about 18 days. Considerable numbers of adults were liberated in several localities, and in one plantation near Rabaul it appears to have become established on a small scale. Larvae of *B. longissima* are occasionally killed by a bacterial disease, and the adults are attacked by two mites, one of which was identified as a species of *Anoplocelaeno*.

Froggatt (J. L.) & O'Connor (B. A.). **Insects associated with the Coco-nut Palm.**—*New Guinea agric. Gaz.* **6** no. 3 pp. 16–32, 9 refs. Rabaul, 1940.

This paper is the first of a proposed series on insects associated with the coconut palm in the Territory of New Guinea. It contains a list of the insects, showing the parts of the palm on which they occur and which of them are major pests, followed by a full account of the work carried out during 1930–38 on the bionomics and control of Tettigoniids of the genus *Sexava*, which are the most serious pests of coconut in the Territory [*cf. R.A.E.*, A **24** 201; **25** 741; **26** 435, 495; **27** 277; **29** 91]. The eggs and adults are briefly described, and detailed descriptions are given of the seven instars of the female nymphs and of the six instars of the micropterous male nymphs. On Manus there also occurs a macropterous form of the male nymph

that has seven instars [*cf.* **25** 741]. The development of a generation from egg to egg was completed in an average of 212 days, of which the egg and nymphal stages lasted 78 and 101 days, and the pre-oviposition period 33 days. The adults survive for only 3½ days without food, but in field cages with ample food, the longevity of males and females averaged 82·8 and 67·1 days. In addition to the food-plants already noticed [*cf.* **24** 201], the Tettigoniids have been observed on *Nipa fruticans*, while in cages they readily consumed the foliage of *Pennisetum macrostacium*.

In connection with the biological control of *Sexava*, it is stated that the egg parasites recorded by Leefmans in 1927 from *S. nubila*, Stål, in Amboina, Netherlands East Indies [*cf.* **16** 130] were the Encyrtid, *Leefmansia bicolor*, Wtstn., the Trichogrammatid, *Doirania leefmansi*, Wtstn., and the Eulophid, *Ootetrastichus dubius*, Wtstn. In 1930, Reyne recorded *O. dubius* and the Scelionid, *Prosapegus atrellus*, Dodd, from eggs of *Sexava*, on the coast of Dutch New Guinea, *O. dubius* from Halmahera, and *D. leefmansi* from the Banngai Islands.

All these species are indigenous to the Territory of New Guinea, where, however, *L. bicolor* is represented by a variety; additional parasites recorded from various islands of the group are two Mymarids and a Eulophid. In New Hanover, the life-cycles of *D. leefmansi*, the indigenous and Amboina varieties of *L. bicolor*, *O. dubius* and the Mymarid that occurs there were completed in 39–41, 31–35, 26–31, 30–36 and 23–25 days, respectively. In Manus, the life-cycle of the Amboina *L. bicolor* lasted 35–49 days if the host eggs used were less than 16 days old, and 20–27 days if they were 16–44 days old. When the adults were supplied with food, their longevity averaged 7 days and ranged up to a fortnight. This parasite became established in the field fairly readily, provided that continual liberations were made from laboratory stocks, but in most cases it failed to survive after liberations had ceased. On New Hanover, however, it has maintained itself for several years

The nymphs and adults of *Sexava* are destroyed by lizards and four species of birds, but no control was afforded by allowing guinea fowls (*Numidia meleagris*) to run in the plantations.

JENKINS (C. F. H.). **Stored-grain Pests.**—*J. Dep. Agric. W. Aust.* (2) **17** no. 3 pp. 295–308, 9 figs., 27 refs. Perth, W.A., 1940.

Owing to war conditions it is probable that stocks of wheat will accumulate in Western Australia. During the war of 1914–18, large quantities of bagged wheat stored in Australia were severely damaged by rodents and insect pests, and emphasis is laid on the necessity of preventing the recurrence of such loss. Brief notes are given on the appearance and bionomics of *Calandra oryzae*, L., *C. granaria*, L., *Rhizopertha dominica*, F., and *Sitotroga cerealella*, Ol., which attack sound grain, and *Tribolium confusum*, Duv., *T. castaneum*, Hbst., *Oryzaephilus surinamensis*, L., and *Laemophloeus* spp., which attack already infested grain, and on preventive measures, including thorough sanitation and control by fumigation and other methods. In addition to the more usual fumigants, mention is made of fumigation by carbon dioxide, which was employed in South Australia during the last war [*R.A.E.*, A **7** 168, 383] and was very effective, provided that a concentration of about 15 per cent. could be maintained for at least three days. If the stacks were made sufficiently air-tight, enough

carbon dioxide was generated by the respiration of the grains and the insects to destroy the latter. All stages of the insects are killed by maintaining the temperature of the whole bulk of the wheat at 120°F. for 3 hours or 130°F. for 30 minutes, but temperatures higher than 145–150°F. may be detrimental to the wheat.

CAMERON (A. E.). **Insect and other Pests of 1939.**—*Trans. Highl. agric. Soc. Scot.* 1940 repr. 25 pp., 10 figs., many refs. Edinburgh, 1940.

In view of the severe damage that may be caused in Scotland to crops grown in ploughed grassland by wireworms and Tipulid larvae, the greater part of this report is devoted to a review of their bionomics and control. A serious outbreak of Aphids occurred in the Lothians in 1939, the most injurious species being *Brevicoryne brassicae*, L., on crucifers, and *Myzus persicae*, Sulz., on crucifers and potatoes. Both these Aphids overwinter on the stems and lower leaves of Brussels sprouts, winter cabbage and cauliflower, the former as an egg and the latter as a wingless female. A brief account is given of their bionomics, and of measures for the control of *B. brassicae* [*R.A.E.*, A **24** 549], which are equally effective against *M. persicae* on crucifers. An atomised pyrethrum spray gave fairly good results in the Lothians [*cf.* **26** 464], but is said to have scorched the leaves elsewhere. *M. persicae* can be controlled on potatoes by 2–3 sprays of 8–10 oz. nicotine sulphate in 50 gals. Bordeaux mixture, applied when the plants are 5–6 weeks old and at intervals of 10–14 days. Accounts are also given of the bionomics, distribution and control of the chrysanthemum midge, *Diarthronomyia chrysanthemi*, Ahlberg [*cf.* **28** 298; **29** 63, etc.], which was first recorded in Scotland in December 1939, when it was found in gardens and greenhouses in Lanarkshire, and of the bionomics and control of *Phytomyza atricornis*, Mg. [**24** 512], which also infests chrysanthemums in Scotland.

KING (C. B. R.). **Notes on the Shot-hole Borer of Tea,** *Xyleborus fornicatus* **Eichhoff** *fornicatior* **Eggers.**—*Tea Quart.* **13** pt. 3 pp. 111–116, 1 ref. Talawakelle, 1940.

The author considers that the Scolytid, *Xyleborus fornicatus*, Eichh., which has a wide range of food-plants, including castor [*Ricinus communis*] and tea, is represented in Ceylon by two subspecies, practically indistinguishable in appearance but differing in biology. One of these, for which the name *fornicatior*, Eggers, should be retained [*cf. R.A.E.*, A **10** 572; **14** 138], is the usual pest of tea and does not attack castor; the other, which is the typical *fornicatus*, infests tea only to a slight extent and only if the plants are in the vicinity of infested castor. The economic importance of Scolytid bark-borers in general and the possibilities of biological control of *X. f. fornicatior* are briefly discussed. It is concluded that such biological control is not feasible, since no parasites or predators of *X. fornicatus*, or closely allied species, are known, and the expense of attempts to find any in countries in which the beetle occurs, but is not of economic importance, would not be justified. It has been suggested that the damage caused to tea bushes by the borer increases their liability to infestation by wood-rot fungi, but the author states that careful experiments have failed to demonstrate any connection between the two.

RANGASWAMI IYENGAR (S.) & GRIFFITH (A. L.). **Entomological Investigations on the Spike Disease of Sandal (35). Further Studies on the Spike Disease of Sandal.**—*Indian For. Rec.* (N.S.) Ent. **6** no. 4 pp. [vii] 85–196, 12 pls. Delhi, 1940.

This paper belongs to a series [*cf. R.A.E.*, A **22** 441, 442; **28** 557] of which nos. 21–33 comprised further lists [*cf.* **22** 311] of insects of various families taken on sandal (*Santalum album*) in southern India. A brief account is given of the organisation of work on the entomological and other aspects of spike disease, and its characteristics are described. Since the morphological symptoms can be induced by factors other than the disease itself, such as mass feeding of insects, sickliness or death of the host plant of the sandal and the association of the latter with certain species of hosts, an apparent case of the disease is not regarded as true spike unless transmission to healthy plants can be effected by grafting and the affected plant dies within a reasonable period. Leaf-grafting was found the most satisfactory for this purpose, and diseased plants usually died within two years of infection.

In experiments in which healthy plants were exposed for two months in a forest in which the disease was prevalent and protected from insects either by day or by night, 3 cases of infection by night but none by day were recorded. Mass transmission experiments were carried out in two areas over several years. Diseased and healthy plants were placed in two cages, and 265 kinds (species or groups) of insects collected at night in sandal forests were introduced into one cage and 219 into the other; lists of them are given in an appendix. Transmission of the disease occurred in both cases. The 17 types of scars that were observed on the plants are briefly described and illustrated. Of the 207 kinds of insects that were introduced into both cages, some are unable to pass through a screen having 4 meshes to the inch [*cf.* **28** 558], some are present in an experimental area in which large numbers of diseased and healthy plants are grown in close proximity but natural transmission does not occur, and others belong to Orders that are not known to include vectors of any virus. From this and other work, including the results of catches by means of papers smeared with an adhesive, an account of which is given in an appendix by N. C. Chatterjee [*cf. loc. cit.*], and of individual transmission tests with 75 species of insects, all of which gave negative results, a list is given of upwards of 35 species of Rhynchota that are likely to include the vector or vectors of the disease.

CAMERON (A. E.). **The Effect of Felling on the Incidence of Forest Insect Pests.**—*Scot. For. J.* **54** pt. 2 pp. 46–52, 2 refs. Edinburgh, 1940.

In view of the large amount of felling rendered necessary in Great Britain by war conditions, brief notes are given on the habits and control of *Hylobius abietis*, L., *Pissodes notatus*, F., *P. pini*, L., *Myelophilus piniperda*, L., *M. minor*, Htg., *Hylastes ater*, Payk., and *Ips* (*Pityogenes*) *bidentatus*, Hbst., which are the most injurious of the insects that increase under conditions of felling [*cf. R.A.E.*, A **28** 408; **29** 323]. Scots pine [*Pinus sylvestris*] is the chief food-plant of these pests, but all of them readily attack other conifers in mixed stands. Felled areas of pure spruce, larch or Douglas fir [*Pseudotsuga taxifolia*] do not support many destructive insects, but among them are

Hylastes ater and *Hylobius abietis*; the latter can become a serious menace to young pine plantations even in localities in which only a small amount of pine material is available for breeding. Suggested control measures include barking infested felled stems to destroy developing broods of bark-beetles before they mature; the bark should be left where it falls to permit the emergence of predators and parasites. The slash in felled areas is of minor importance in the breeding of pine beetles [**28** 409], but the stumps provide a rich supply of breeding material for *Hylobius abietis*, *Hylastes ater* and *Myelophilus*. It is therefore desirable to burn the slash on the stumps of the late crops, as this makes them more attractive to Longicorns, the larvae of which use up the food-supply of *Hylobius* and the Scolytids.

CAMERON (A. E.). **The Pine-bud Tortrix Moth in Aberdeenshire.**—*Scot. For. J.* **54** pt. 2 pp. 80–82. Edinburgh, 1940.

Adults from larvae found in the buds of Scots pine [*Pinus sylvestris*] in Aberdeenshire in the early months of 1940 were identified as *Rhyacionia* (*Evetria*) *turionana*, Hb., which is one of the three important Tortricids that injure *P. sylvestris* in Britain [*cf. R.A.E.*, A **17** 13]. The larvae occurred in the central buds of the apical whorls, which were coated with resin. The life-cycle of *R. turionana* lasts one year; the eggs are laid in May and June, on or near the buds, and hatch in about three weeks. The larva bores into a bud near its apex and forms a burrow, in which it hibernates. It feeds in adjoining healthy buds in early spring and pupates in an excavated bud about the end of April. The adult emerges two or three weeks later. *R. turionana* can be almost as injurious as *R.* (*E.*) *buoliana*, Schiff., in plantations 3–15 years old, and it may cause severe distortion and retardation of growth in heavy infestations. *R.* (*E.*) *resinella*, L., is less important, as it rarely destroys the buds [*cf.* **28** 132]. Dominant trees that overtop the canopy are most liable to infestation, and it is suggested that such trees should be removed in winter and burnt or otherwise destroyed while the larvae are in the buds. Infested buds, which can easily be distinguished from healthy ones towards the end of April, can be removed and destroyed, or, preferably, kept in a box covered with gauze of a mesh big enough to permit the escape of parasites but not of the moths. Pine should not be planted in pure stands, since these are more heavily infested than mixed stands, and hardwood trees should be grown round the pine plantations where soil conditions permit.

WRIGHT (D. W.). **The Control of Cabbage Root Fly.**—*Agriculture* **46** no. 8 pp. 765–772, 1 pl., 1 ref. London, 1940. **Further Experiments on the Control of the Cabbage Root Fly** (*Delia* (*Hylemyia*) *brassicae* **Bouché**).—*Op. cit.* **47** no. 3 pp. 187–191, 1 pl., 2 refs. 1940.

In the first of these papers, an account is given of further work [*cf. R.A.E.*, A **27** 116], carried out in eastern England in 1939, on the control of *Hylemyia* (*Delia*) *brassicae*, Bch., on the roots of crucifers by means of dusts containing 4 per cent. mercurous chloride (calomel) or a solution of 1 oz. mercury bichloride in 10 gals. water, which was applied at the rate of $\frac{1}{4}$ pint per plant. In all cases, the rates of application of the dust were 45 lb. per 4,840 plants when they were

treated once and 30 lb. for each treatment when they were treated twice. It was applied from a hand apparatus of the piston type so as to produce a layer on the soil round the base of the plant. Cauliflowers set out on 19th April were given a single application of the dust on 21st April, or two applications of the dust or the solution on 21st April and again on 5th May, on which date eggs of *H. brassicae* were first observed. The percentage increases in total weight of heads over the controls were 62·6, 61·6 and 3·1 for the three treatments, respectively, and the first one almost trebled the percentage of first grade heads as compared with the control. The examination of the stumps showed that the yield of the crop was almost directly correlated with the severity of the damage caused to the root system by the larvae of the fly, the percentage of plants not attacked being 60, 69·4 and 0, respectively. In another series of plots, on which only the dust was used and in which the effect was tested of delaying the first application of dust until a fortnight after the eggs were first observed, the first application was made on 23rd May, by which time some larvae had hatched, and the second on 6th June. The resulting crop compared poorly both in total weight and quality with those from the other plots given 1 or 2 applications at the correct time.

In experiments with spring-sown brussels sprouts, two applications of dust, 2 and 16 days after the plants were set out, resulted in 30 per cent. increase in yield as compared with the control plots; a single application gave only 19 per cent. increase, and 3 applications of the mercury bichloride solution had no effect on the crop.

Laboratory experiments showed that contact with mercurous chloride or its vapour kills the eggs of *H. brassicae*, and in field observations, the percentage hatch of eggs collected round plants given 1 or 2 applications of dust was 6 and 3, respectively. Since *H. brassicae* continues to oviposit throughout the summer, it is important that the dust should remain undisturbed round the base of the plants as long as possible, and close hoeing or weeding should, therefore, be avoided.

It is recommended that plants set out before the last week of April should be dusted during that week, whereas those set out during or after it should be dusted within 4 days of setting out. One application at the rate of 45 lb. to 4,840 plants is sufficient for cauliflowers, and two each at the rate of 30 lb. for brussels sprouts or broccoli, the second application to be made 2–3 weeks after the first.

In the second paper it is pointed out that infestation by *H. brassicae* also occurs in seedbeds. In experiments in 1940 on control in seedbeds of broccoli, the percentages of unattacked plants were 22·5 when the seed was coated before sowing with 1½ lb. mercurous chloride per lb. seed, 95 and 90·8 for a single application of the 4 per cent. dust at rates of 1 lb. per 60 and 80 yds. of row when the seedlings showed 2–3 rough leaves, 82·5 for 2 applications at an interval of a week of the mercury bichloride solution at the rate of 1 gal. per 22·5 yds., also when the plants showed 2–3 rough leaves, and 13·8 for untreated seedlings. If there are many larvae in the roots at the time of transplanting, the roots and the base of the stem should be dipped for 3–5 minutes in a solution of 1 oz. 98 per cent. nicotine in 4 gals. water before setting out. The roots should first be washed in water to remove the soil, and no wetting agent should be added to the nicotine. Plants that are also infested by the cabbage Aphid [*Brevicoryne brassicae*, L.] should be completely immersed.

In a comparative experiment in 1940 on the effect on the yield of early cauliflowers of the mercurous chloride dust and nitro-chalk at rates of 45 lb. and 1 cwt. per 4,840 plants, respectively, the former was applied on 30th April and the latter (close to the bases of the plants) on 16th May. The resulting percentage increases in weight of heads and in the numbers of first-grade heads over the controls averaged 10 and 16·7 for nitro-chalk, 110·4 and 229·1 for mercurous chloride, and 204·4 and 387·6 for a combination of both treatments. The percentages of undamaged roots were 0, 87 and 89. Plants that received both treatments were more vigorous and darker in colour than those given mercurous chloride only, but no cases of severe attack occurred among either.

Heidenreich (E.). **Der Hausbockkäfer. Erkennung und Bekämpfung unter Berücksichtigung anderer tierischer Holzschädlinge.** [*Hylotrupes bajulus*, L., Recognition and Control with Consideration of other Pests of Timber.]—Demy 8vo, 43 pp., 39 figs., 1 ref. Eberswalde, Verlag R. Müller, 1939. [Recd. 1941.]

This booklet, which is intended for house-owners and builders, comprises a survey of information on the habits and control of *Hylotrupes bajulus*, L., in constructional timber in Germany, together with brief notes on other pests of timber, including Longicorns and Siricids, that are introduced in the course of building, and Anobiids. The section on the control of *H. bajulus* comprises 16 pages, but although treatments are recommended for infested wood and for the prevention of infestation in sound wood, details of the methods are not given and the substances to be used can be ascertained only by application to official institutes. Legal restrictions in Germany prevent the application by householders and other unauthorised persons of effective treatment by heat or fumigation.

Compere (H.). **Parasites of the Black Scale, *Saissetia oleae*, in Africa.** —*Hilgardia* **13** no. 7 pp. 387–425, 7 figs., 33 refs. Berkeley Calif., 1939. [Recd. 1941.]

A list is given of 28 species of primary parasites of *Saissetia oleae*, Bern., collected in Africa and shipped to California in 1936–37, including references to original descriptions and synonyms, records of places from which they were collected, notes on distinguishing characters of some of them, descriptions of the new species, and biological notes by S. E. Flanders on those reared in the insectary in California. The 28 species comprised : *Diversinervus smithi*, sp. n., *Coccophagus trifasciatus*, Comp., *C. pulvinariae*, Comp., *C. capensis*, Comp., *C. cowperi*, Gir., *C. anthracinus*, Comp., *Metaphycus lounsburyi*, How., *M. helvolus*, Comp., *Scutellista cyanea*, Motsch., and *Euxanthellus* sp. from South Africa ; *Coccophagus ochraceus*, How., and *Encyrtus fuliginosus*, sp. n., from South Africa and Kenya ; *Metaphycus stanleyi*, Comp., from South Africa and Uganda ; *Coccophagus rusti*, Comp., from Kenya, Uganda and South Africa ; *Coccidoxenus niloticus*, sp. n., *Coccophagus basalis*, Comp., *C. nigritus*, Comp., and *Microterys kenyaensis*, Comp., from Kenya ; *Coccophagus spectabilis*, Comp., *C. coracinus*, sp. n., *C. eleaphilus*, Silv., *C. saintebeauvei*, Gir., *Diversinervus elegans*, Silv., *Metaphycus* sp. and *Mesopeltis* sp. from Kenya and Uganda ; and *Coccophagus flavidus*, sp. n., *Diversinervus masakaensis*, sp. n., and

Microterys saissetiae, Comp., from Uganda. A key is given to the females of all the above species of *Coccophagus* and nine additional ones that parasitise *S. oleae* in various parts of the world.

Between 27th November 1936 and 13th July 1937, 24 lots of insects were shipped from Africa to California for propagation, the journey, part of which was made by air, lasting 18 days or less. Of these shipments 16 contained parasitised examples of *S. oleae*. Of the 28 species reared from it, *C. capensis*, *C. ochraceus*, *C. trifasciatus*, *Metaphycus lounsburyi* and *S. cyanea* were already established in California, some were too weak upon arrival to permit reproduction and others failed because of want of males at the proper time, but ten species not previously colonised in California were successfully propagated and released in *Citrus* orchards infested by *S. oleae*. These comprised *Coccidoxenus niloticus*, *Coccophagus cowperi*, *C. pulvinariae*, *C. rusti*, *D. smithi*, *E. fuliginosus*, *Mesopeltis* sp., *Metaphycus helvolus*, *M. stanleyi* and *Microterys saissetiae*. All reproduced in more than one of the orchards in which they were released, and *Metaphycus stanleyi*, *M. helvolus*, *Coccophagus rusti* and *C. pulvinariae* appear to be permanently established.

The hyperparasites, *Baeoanusia minor*, Silv., and *Tetrastichus injuriosus*, Comp., were obtained from the African material and were destroyed.

Bedford (H. W.). **Entomological Section, Agricultural Research Service. Report . . . 1937 38.**—*Rep. agric. Res. Serv. Sudan 1938* pp. 50–71, 1 fldg map. [Wad Medani, 1940.]

Details are given of the local distribution of insect pests of cotton and other crops in the Anglo-Egyptian Sudan during 1937–38 [*cf. R.A.E.*, A **27** 572]. Infestation of cotton by *Platyedra gossypiella*, Saund., was on the whole not more severe, although in the Shambat district of Khartoum Province the percentage of bolls of Egyptian cotton that were injured in December amounted to 51, as compared with 19 in the previous season. There was a marked increase in the percentage of damaged bolls in the Gezira towards the end of the season owing to a decline in the number of bolls per acre ; the percentage loss of saleable cotton due to infestation was 11·8. In the Nuba Mountains, the total shedding of buds and bolls due to all causes decreased in the Kadugli district by 43 per cent. as compared with the previous season, and only 15·5 per cent. of the shedding was due to bollworms, *Diparopsis castanea*, Hmps., being responsible for 6·5 per cent. and *Heliothis armigera*, Hb., for 5·5 per cent. In the Talodi district, bollworms were responsible for 15·4 per cent. of the total shedding, of which 8·7 per cent. was caused by *D. castanea*. Two adults of *P. gossypiella* were bred from fruits of *Abutilon* sp. collected at Kadugli during July and September, this being the first time it has been recorded from an alternate food-plant in the Nuba Mountains. Quantities of cotton sticks remain uncut in the outlying districts, and it was demonstrated that resting larvae of *P. gossypiella* can survive in old bolls on them and give rise to further infestation when new bolls are formed. At Kadugli, the percentage parasitism of the larvae of *P. gossypiella* by *Microbracon kirkpatricki*, Wlkn., was 10 in November, 3·5 in December and 10·8 in January. In Equatoria Province, both *P. gossypiella* and *Earias insulana*, Boisd., were more abundant than

in the previous season ; of the total shedding of buds and bolls, 26 per cent. was due to bollworms, of which *E. insulana* caused about half. Infestation by this species was highest in December irrespective of the date of sowing of the cotton, whereas in the case of *P. gossypiella*, cotton sown in mid-May, mid-July and mid-August was most severely infested in October, December and January, respectively.

Hercothrips fumipennis, Bagn. & Cam., did serious damage to later sown cotton in the Gash Delta during October, while infestation by *H. sudanensis*, Bagn. & Cam., increased in certain localities in the south of the Gezira during January and caused severe leaf-shedding. *Bemisia tabaci*, Gennadius (*gossypiperda*, Misra & Lamba) was numerous in August on *Ipomoea cordofana* in the southern blocks in the Nuba Mountains and migrated to cotton in September ; the population decreased on cotton after October and increased on *Dolichos lablab*. *Empoasca lybica*, Berg., was more abundant than usual on cotton in the Gezira, the most serious damage being caused in October–December in the more northerly blocks. This Jassid was especially abundant on *D. lablab* early in June, and during the second half of the month it also occurred on *Hibiscus esculentus*, *Cajanus cajan* (*indicus*), *Rhynchosia memnonia*, lucerne and *Sorghum* ; there was a general decrease in mid-July, but in August infestation increased on *D. lablab*, *H. esculentus*, *Withania somnifera* and *Ocimum basilicum*.

Dysdercus fasciatus, Sign., was again the predominant cotton stainer in the Nuba Mountains, but serious damage was caused only to cotton grown near to *Adansonia digitata*. It was recorded for the first time breeding on fruits of *H. esculentus* at Kadugli from April to July and again from February to May. *D. superstitiosus*, F., predominated in Equatoria Province ; the peak of infestation occurred in October at Maridi and in November at Moru, and the percentages of severely injured bolls reached 19 and 12, respectively. In the Nuba Mountains, *D. superstitiosus* bred on *H. esculentus* in April–August, on *Abutilon* in July and on *Sida* sp., from which it had not previously been recorded, in September and October. In Equatoria Province, *D. superstitiosus* and *D. nigrofasciatus*, Stål, bred readily on kapok and *Sterculia* from July until May. *Podagrica puncticollis*, Weise, was abundant on *Abutilon* and *H. esculentus* throughout July and the first half of August in the Gezira and migrated to seedling cotton in the second half of August. In the Nuba Mountains, the flea-beetle occurred on a number of plants and migrated to new cotton in June and July.

Descriptions are given of several abnormal conditions observed on cotton in Northern Province. In cage experiments, a form of " crazy top " was apparently caused by the feeding of the Capsids, *Creontiades pallidus*, Ramb., and *Campylomma nicolasi*, Puton & Reut. [*cf.* **27** 574], which attacked the floral and adventitious buds and the growing points ; the condition was apparently not due to a virus, since the plants recovered from a light attack after the bugs had been removed, the symptoms were not transmitted by grafting and they were similar irrespective of whether the bugs had been transferred from lucerne or from damaged cotton. Termites attacked cotton in several areas and became a major pest from January to March in the Tokar Delta. Injury by them was considerably reduced in the Gezira by the application of sawdust containing 1 per cent. Paris green.

In Northern Province, *Sesamia cretica*, Led., is a serious pest of maize and *Sorghum*, which are grown in three crops, summer, autumn and winter. Adults emerged for periods of about two months from

stored stalks of the summer and autumn crops, and continued to emerge from the stalks of stored winter *Sorghum* for as long as six months after harvest (February), which would be sufficient to carry the infestation over to the autumn crop. The shorter period would carry it over from one crop to the next, but this can be prevented by uprooting the plants after cutting the stalks and by exposing the stalks to the sun before storage [*cf.* **27** 574]. In addition to *Tetranychus telarius*, L., which causes little injury to them, date palms in Northern Province are infested by a species of *Paratetranychus* that covers the developing fruit-clusters with webbing, so that they are stunted. It is favoured by lack of moisture, exposure to drying winds and overcrowding of the fruit bunches. Pests of leguminous crops that were injurious in the Gezira included the Galerucid, *Luperodes quaternus*, Fairm., and larvae of *Adoretus* sp. on *Dolichos lablab*, and *Colias marnoana*, Rogenh., which severely infested lucerne in April. The Pentatomid, *Aspongopus viduatus*, F., was responsible for a complete failure of the early melon crop in the Dongola district and near Wadi Halfa ; melons sown later (early March) escaped infestation.

Owing to exceptionally good late rains, considerable breeding of *Schistocerca gregaria*, Forsk., took place to the north of Port Sudan from February to April, but control measures were successfully applied before the end of April. Considerable swarms of *Locusta migratoria migratorioides*, R. & F., entered Equatoria Province from the Belgian Congo during April and May, and extensive breeding occurred. In July, a swarm of *Nomadacris septemfasciata*, Serv., entered the Sudan from Uganda for the first time on record. It proceeded northwards up the Nile Valley and dispersed on reaching Northern Province, but no breeding was reported.

ARROW (G. J.). **Some undescribed Species of Melolonthid Coleoptera from Western New Guinea and the adjacent Islands of Waigeu and Japen.**—*Ann. Mag. nat. Hist.* (11) **7** no. 41 pp. 448–464. London, 1941.

This paper includes a note in which the name *Dermolepida* is proposed for the Melolonthid genus *Lepidoderma*, the latter name being preoccupied.

BELL (A. F.). **Report of the Division of Entomology and Pathology.**—*Rep. Bur. Sug. Exp. Stas Qd* **40** pp. 16–20. Brisbane, 1940.

In the year ending June 1940, infestation of sugar-cane in northern Queensland by the larvae of the Melolonthid, *Dermolepida* (*Lepidoderma*) *albohirtum*, Waterh., continued to increase [*cf. R.A.E.*, A **28** 401], and serious losses were caused in many mill areas. This was chiefly because soil-fumigation was not carried out effectively, as insufficient quantities of fumigant were available at the optimum time for treatment, a prolonged flight period rendered timing difficult, there were large areas of light infestation that did not appear to warrant fumigation but in which considerable crop losses occurred, and the soil was too sodden to be treated during part of the fumigation period. The clearing from the cane-lands of trees that serve as food-plants for the adult beetles has proved of much value in some cases, and this measure has been undertaken in several localities. In field observations of the resistance of different varieties of cane to infestation, which were

carried out during a particularly wet season when the larvae tended to congregate near the surface, P.O.J. 2725 showed a considerable degree of resistance and Q.29 appeared to be unattractive to the adults owing to its rather sparse early growth. P.O.J. 2878 and Co. 290 showed less resistance than P.O.J. 2725.

Rhabdocnemis obscura, Boisd., was somewhat less destructive than in previous years, although very wet conditions prevailed. In one locality it chiefly attacked cane that had been injured by *D. albohirtum*. The giant toad, *Bufo marinus*, was numerous in cane-fields in the wetter areas where *R. obscura* thrives, which indicates that it may be effective in controlling the migrating weevils, but was present in insufficient numbers in cane plots infested by *D. albohirtum*, probably owing to the absence of any débris that would serve as shelter during the day, and in general appears to afford only slight control of this beetle.

Further severe infestation of sugar-cane by *Aulacaspis madiunensis*, Zehnt., occurred in the Bundaberg district [*cf.* **28** 402]; a survey showed that this Coccid was injurious only on standover cane, which constituted a large percentage of the crop, and was rare on cane less than a year old. The variety P.O.J. 213 was the worst affected, followed by P.O.J. 2878; P.O.J. 2725 and Co. 290 appeared to be fairly resistant. Recommendations included the burning of affected blocks and the elimination of P.O.J. 213, which appears to have been largely instrumental in building up the infestation.

LEVER (R. J. A. W.). **Insect Pests of Citrus, Pineapple and Tobacco.**—*Agric. J. Fiji* **11** no. 4 pp. 99–101, 12 refs. Suva, 1940.

The most important pests of *Citrus* in Fiji are fruit-flies [*cf. R.A.E.*, A **24** 446], but it is also attacked by the Coreid, *Mictis profana*, F., and the Pentatomid, *Tectocoris diophthalmus*, Thnb. (*lineola*, F.), which damage the shoots, the Coccids, *Fiorinia proboscidaria*, Green, *Lepidosaphes beckii*, Newm., *Prontaspis* (*Chionaspis*) *citri*, Comst., *Pseudococcus citri*, Risso, *Coccus hesperidum*, L., *Aonidiella aurantii*, Mask., and *Icerya seychellarum*, Westw., and the fruit-piercing moth, *Othreis fullonia*, Cl. (*fullonica*, L.), the larvae of which are stated to feed on the leaves as do those of *Papilio schmeltzi*, H.-S. *Aphis citricidus*, Kirk., is often abundant on young growth and can be controlled by means of sprays containing an emulsion of kerosene or Diesel oil. The leaves are attacked by a weevil of the genus *Rhinoscapha*, which is recorded under a specific name that is corrected in a subsequent paper [**29** 000] to *R. lagopyga*, Fairm.; it can be controlled by lead-arsenate sprays. Another weevil, *Elytroteinus subtruncatus*, Fairm., damages the fruits of lemon and is preyed upon by the introduced toad [*Bufo marinus*]. *Xyleborus testaceus*, Wlk., and *Crossotarsus saundersi*, Chapuis, which were recently recorded from the trunks of grapefruit on inadequately drained soil [**29** 169, 170], can be controlled by improving the drainage and whitewashing the trunks.

Potentially the most serious pest of pineapple in Fiji is the Dynastid, *Anomocaulus fulvovestitus*, Fairm., which injures the leaves and bores into the heart, but it is very scarce. *Pseudococcus brevipes*, Ckll., was present on pineapple in Ovalau in 1938, but was not associated with wilt. Of three Chrysopids recently observed to be predacious on *P. brevipes* in Fiji, two have been identified as *Chrysopa ramburi*, Schneider, and *C. irregularis*, Banks. Adults of a Scelionid emerged

from Chrysopid eggs sent to Hawaii. Infestation by *Diaspis bromeliae*, Kerner, is not of great importance. *Carpophilus dimidiatus*, F., *C. mutabilis*, Fairm., *C. hemipterus*, L., and *C. humeralis*, F., are common on pineapple fruits injured by *A. fulvovestitus* or heavily infested by *P. brevipes*; these Nitidulids are unable to damage the fruit unaided, but their presence in canned pineapple constitutes a nuisance. The removal of decaying and fermented fruit and fruit refuse, in which they breed, quickly checks an outbreak, and, as they are attracted to strong light, they can be controlled in the canning sheds by reducing the light there. Two other Nitidulids, *Haptoncus ocularis*, Fairm., and *Epuraea* (*H.*) *luteola*, Erichson, were taken on Taveuni in decayed fruits of *Citrus* and pineapple. The cockroach, *Pycnoscelus surinamensis*, L., is common among diseased roots of pineapple in Fiji, and the prompt removal of all diseased material is advisable, since in Hawaii it also attacks living roots.

The pests of tobacco in Fiji include *Heliothis armigera*, Hb., and *Agrotis ypsilon*, Hfn., which are the most important but can be controlled by means of a poison bran bait, *Gnorimoschema heliopa*, Lower, and *G.* (*P.*) *operculella*, Zell., which have been recorded locally in the past but are not now injurious, and *Epilachna vigintioctopunctata*, F., which can be controlled by sprays of lead arsenate or dusts of pyrethrum. The Phorids, *Diploneura cornuta*, Big. (*cleghorni*, Big.), and *Megascelia scalaris*, Lw., were recently bred by the author from dead larvae of *H. armigera*. The measure recommended against *Lasioderma serricorne*, F., which tunnels in cheroots and cigars that are left exposed, is fumigation with carbon bisulphide at the rate of 1 oz. per 50 cu. ft.

LEVER (R. J. A. W.). **New Host Records of Pests.**—*Agric. J. Fiji* **11** no. 4 p. 117, 3 refs. Suva, 1940.

Epilachna vigintioctopunctata, F., which attacks vegetable marrow and tobacco in Fiji in addition to other food-plants already recorded [*R.A.E.*, A **27** 641], has recently been observed defoliating potato and injuring ground-nuts [*Arachis hypogaea*]. *Heliothis armigera*, Hb., which normally attacks tomato and maize, damaged pods of *Cajanus cajan* in Lautoka. A Coreid of the genus *Brachylybas* is here recorded from tomato and *Piper* (*Macropiper*) *methysticum* and was previously recorded in notes on pests of taro [*Colocasia esculentum*] under a specific name that does not exist. It was therefore omitted from the abstract of these notes [**29** 170]. The name is corrected, however, to *B. variegatus*, Le Guillou, in a subsequent paper [see next abstract].

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **12** no. 1 pp. 19–22, 24 refs. Suva, 1941.

Brief notes are given on the duration of development of *Epilachna vigintioctopunctata*, L., on potato in the laboratory in Fiji, where a generation was completed in about 4 weeks in November–December.

The lower surfaces of leaves of the Malay apple (*Eugenia malaccensis*) examined in December and January were found to be covered with open reddish warts, sometimes sufficiently numerous to form a crust, from which adults of the Psyllid, *Megatrioza vitiensis*, Kirk., were reared. A Lepidopterous larva and a Braconid believed to be parasitic on the Psyllid were also associated with the galls. The distribution of *M. vitiensis* is briefly discussed.

In a brief section dealing chiefly with corrections to the names erroneously used by the author for several insects, including those mentioned in the two preceding abstracts, it is stated that large numbers of *Lasioderma serricorne*, F., parasitised by *Lariophagus distinguendus*, Först., and by *Bruchophagus* sp. were found in sacks of coriander seed received from New South Wales.

JACQUES (C.). **Les insectes nuisibles aux végétaux et aux récoltes en Nouvelle-Calédonie. Conservation des grains.**—*Rev. agric. Nouv.-Calédonie* 1940 pp. 4121–4137, 5 figs. Nouméa, 1940.

This is a popular account of the principal pests of crops and stored products in New Caledonia and measures for their control. The field pests for which scientific names are given are *Cosmopolites sordidus*, Germ., on banana, *Brontispa longissima*, Gestro (*froggatti*, Sharp) and *Rhynchophorus* sp., on coconut, *Plutella maculipennis*, Curt. (*cruciferarum*, Zell.) on cabbage, and a fruit-piercing moth of the genus *Othreis*.

BONDAR (G.). **Dois lepidopteros nocivos ao cacaueiro.** [Two Lepidoptera harmful to Cacao.]—*Bahia rural* **5** no. 53 pp. 2009–2010, 1 fig. Bahia, 1938. [Recd. 1941.]

Brief descriptions are given of the larvae and adults of the Arctiids, *Pelochyta arontes*, Cram., and *Opharus astur*, Cram., the larvae of which feed on the leaves of cacao as well as indigenous plants in Bahia, Brazil, but cause no serious injury. The pupal stage in both species lasts 13–15 days.

BONDAR (G.). **Insectos damninhos ás fruteiras, da familia de moraceas.** [Pests of Fruit Trees of the Family Moraceae.]—*Bahia rural* **5** no. 56–57 pp. 2177–2180, 5 figs.; no. 60–61 pp. 2286–2288. Bahia, 1938. [Recd. 1941.]

Notes are given on the bionomics, control and appearance of the various stages of insect pests of cultivated fig (*Ficus carica*) and jak (*Artocarpus integrifolia*) in Brazil. Most of those that attack cultivated fig have migrated to it from native wild figs, and none of them occurs in the Mediterranean region where *F. carica* originated. The majority are Coleopterous borers, infestation by which can be reduced by applying a repellent, such as lime-wash, to the trunks and branches to prevent oviposition. One of the most important is the Buprestid, *Colobogaster cyanitarsis*, Lap. & Gory, which mines in the trunks and branches and also attacks *Ficus benjamina*, *F. religiosa* and *F. elastica*, which are grown in towns as ornamentals. The females oviposit from November to February in the bark, under which the larva tunnels downwards for several months. The mine may extend for 2–3 ft., and even 6 ft. in wild figs. The trees become stunted in growth, and may die if the galleries interrupt the circulation of the sap. Pupation takes place in the lower part of the mine, and the adult emerges 3 weeks later. The total life-cycle probably lasts at least one year and usually two. *C. quadridentata*, F., has also been observed in *F. benjamina*, *F. elastica* and wild figs, and is probably able to breed in *F. carica*. Larvae of the Lamiid, *Taeniotes scalaris*, F., mine in the living wood of cultivated and wild figs, especially those in poor condition. The larvae should be dug out with a knife, and severely

infested branches should be cut off and burned. Similar injury is caused to cultivated fig by the Cerambycid, *Coleoxestia spinipennis*, Serv., which also attacks orange.

The Pyralid, *Azochis gripusalis*, Wlk., is the chief pest of fig in Bahia and is widespread wherever figs are cultivated in Brazil. It oviposits, usually in the leaf-axils, when the new shoots appear. The larvae enter the peduncles and shoots and even penetrate to the woody parts. Infestation occurs throughout the vegetative season. All punctured and withered parts of the tree and all infested shoots should be cut off and burned; if it is desired to preserve a particular branch, the larvae may be killed in their mines by means of a wire. In São Paulo, the measures adopted against this Pyralid are pruning fig trees annually down to the stumps, and applying lime-wash or Bordeaux mixture to these in spring before the shoots appear. The larvae of the Sphingid, *Pachylia ficus*, L., which normally infests *F. benjamina*, *F. elastica* and wild figs, appear sporadically on *F. carica*, doing great injury to the shoots and leaves. They can be controlled by spraying with Paris green or, if the fruits are already formed, by hand collection. Fig is attacked by various Coccids, of which the commonest is *Morganella maskelli*, Ckll.

The pests of *Artocarpus integrifolia* include the Lamiid, *Acrocinus longimanus*, L., which also infests wild figs. The eggs are laid in incisions in the bark and hatch in 7–10 days. The larvae feed at first in the new wood beneath the bark, and their presence is indicated by the accumulation of frass at the foot of the tree. After 7–8 months they penetrate into the wood to a depth of about 4 inches and pupate. In Bahia, the trees are very often killed by the attack. The best method of control is to lift the bark carefully and remove and destroy the larvae. Larvae of *Pantophthalmus vittatus*, Wied., and *P. gigas*, End., bore in the wood of the trunk of various trees, including *A. integrifolia*. *P. vittatus*, which is the commoner, prefers weak or recently fallen trees, but sometimes attacks and even kills trees in full vigour. The females oviposit in the bark, and the presence of the larvae is revealed by frass and sap on the trunk. The life-cycle probably lasts about two years. Adults of *Taeniotes scalaris* feed on the leaves and cause considerable injury to young plants in nurseries.

Silva (P.). **Mais um Membracideo nocivo ao cacaueiro.** [Another Membracid harmful to Cacao.] —*Bahia rural* **6** no. 62 p. 7, 2 figs., 4 refs. Bahia, 1939. [Recd. 1941.]

A brief description is given of the adult of the Membracid, *Hoplophorion pertusa*, Germ. (*Hoplophora porosa*, Wlk.), which was observed to attack cacao in Bahia and has also been recorded from *Citrus*, willow, and poplar in Brazil. On cacao, the eggs are laid in incisions and the nymphs and adults suck the sap of young branches, causing them to wither and sometimes killing young plants. The wounds afford access to injurious fungi. In nurseries, the bug can be controlled by hand collection or by spraying with kerosene emulsion.

Tessier (G. A.). **Nouvelle diète pour le dermeste du lard.**—*Forêt québecoife* **3** no. 1 pp. 29–34, 1 fig. Quebec, 1941.

Larvae of *Dermestes lardarius*, L., were observed in Quebec in July 1940 boring into timber stacked in a warehouse below a floor on which

dried herrings had been stored some time previously. After the fish was removed, development had apparently continued in beams and floor boards impregnated with fish oil, and larvae dropped down to the floor below, where they bored into the timber in order to pupate.

Brief notes are given on the biology of this Dermestid. As the building could not be effectively sealed, the infestation could not be controlled by fumigation or heat. Various liquid insecticides were applied copiously to samples of the infested floor boards, and the latter were examined 24–30 hours later. The most effective was kerosene, which killed all the larvae and almost all the pupae and adults ; it was not rendered more effective by the addition of pyrethrum. A mixture of 2 parts ethyl acetate and 3 parts carbon tetrachloride gave good control of the larvae and pupae, but was somewhat less effective against the adults, though it has the advantage of being non-inflammable.

FARSTAD (C.). **The Development of Western Wheat Stem Sawfly (*Cephus cinctus* Nort.) in various Host Plants as an Index of Resistance.**—*Iowa St. Coll. J. Sci.* **15** no. 1 pp. 67–69. Ames, Iowa, 1940.

An investigation was started in western Canada in 1933 on the possibility of producing a commercially desirable wheat that would be resistant to *Cephus cinctus*, Nort., and a study of its development in some of its wild and cultivated food-plants was begun in 1937 with a view to finding the factors concerned in resistance. The resistance appeared to be mechanical rather than nutritional, and was related to the amount and consistency of the pith tissue. *Agropyrum elongatum*, an introduced grass, which can be crossed with wheat, was found to be highly resistant. *Phleum pratense* was also resistant, as the larvae burrowing in the base of the stem were apparently crushed by the growth of the surrounding tissue in spring. Varieties of oats appeared to be entirely resistant and to be deficient in some nutritional factor that is essential to the growth of the larvae.

PAUL (L. C.). **Appraisal of Grasshopper Control Methods in Saskatchewan.**—*Iowa St. Coll. J. Sci.* **15** no. 1 pp. 95–97. Ames, Iowa, 1940.

This is a summary of a thesis comprising a detailed statistical analysis of the methods and results of grasshopper control in Saskatchewan in 1934, based on records from 1,620 fields, totalling 83,709 acres of crops. It is estimated that the average loss was 24 per cent. of the crops, that the loss without control would have been 66 per cent., and that the value of the crop saved was 32 times the expenditure on baits and on the local control organisation. By grouping blocks of farms according to types and intensities of infestation, and to agricultural practices, it was shown that the importance of individual control methods varied locally, but that in every area the yield per acre was significantly correlated with at least one control factor. With severe stubble infestations by *Melanoplus mexicanus mexicanus*, Sauss., the yields were correlated with the proportion of crop sown on uninfested fallow. With sod infestations by *Camnula pellucida*, Scud., the use of tillage to prevent invasion by hoppers and the timely application of poison bait were more important than the method of

sowing. Ploughing in autumn and spring were equally efficient in reducing egg infestations in stubble fields and were more effective than shallow tillage in the autumn, which in turn was superior to shallow spring tillage. Early sowing (before 15th May) resulted in higher yields than later sowing. It is recommended that, in order to minimise crop losses from severe stubble infestations, sowing should be done on land that has been summer fallowed and ploughed in the autumn. All fields prepared for summer fallow should be surrounded by black guard-strips before the hoppers hatch and worked as soon as possible after hatching is complete. Trap-strips of volunteer growth should be left at intervals, so that the hoppers may concentrate on them and be poisoned with bait. The actual control programme in every area should be adapted to local conditions and based on a combination of farm practices planned for the best utilisation of available resources, protective tillage, and the use of poisoned bait.

SPENCER (G. J.). **The Effect of Hailstorms on Grasshoppers.**—*Canad. Ent.* **72** no. 12 pp. 233–234. Guelph, Ont., 1940.

Observations made in British Columbia in 1930 and 1939 show that hailstorms, which occur there in July, have little or no effect on grasshoppers, for when hoppers and adults of *Camnula pellucida*, Scud., *Melanoplus mexicanus mexicanus*, Sauss., and *M. packardi*, Scud., were buried by layers of hailstones, under which the temperature fell to 33–34°F., they became active again as soon as the temperature rose. In Saskatchewan the hailstorms are more violent and may destroy all insect life along their paths, but these soon become repopulated by invasion from adjoining areas.

HANDFORD (R. H.). **Egg Deposits of a Type not usually produced by** *Melanoplus mexicanus mexicanus* **(Sauss.) in Manitoba.**—*Canad. Ent.* **72** no. 12 p. 235. Guelph, Ont., 1940.

In Manitoba, the egg-pods of *Melanoplus mexicanus mexicanus*, Sauss., are usually widely scattered on cultivated fields with light soils, and concentrations are confined to ridges of drift soil. In the autumn of 1938, however, there was concentrated laying by immigrants from the Dakotas, which oviposited in the heavy soils of woodland pastures in the section of Lang's Valley occupied by the Pembina river, where the valley narrows to 3 miles and deepens to 300–450 ft. The flight of the grasshoppers into the valley began in early August and continued in September, and the infestation, which was particularly dense on small grassland plots among woodland, reached a density of 52 pods per sq. ft. Most of the eggs survived, and in June 1939 the density of hoppers on some grassy clearings was 1,000 per sq. ft. The tendency for migrating grasshoppers to alight in deep valleys is not unusual, and during the exceptionally dry and hot autumn of 1938 the concentration in the valley may have been helped by the presence there of green vegetation, while the usually heavy soils became sufficiently friable to be suitable for oviposition.

FINLAYSON (L. R.) & GREEN (T.). **A Note on the Effect of certain Foods upon Fecundity and Longevity in** *Microcryptus basizonus* **Grav. (Hymenoptera).**—*Canad. Ent.* **72** no. 12 pp. 236–238, 2 refs. Guelph, Ont., 1940.

An investigation was carried out in 1939 to compare the value of a mixture of 25 cc. honey, 25 gm. sugar and 50 cc. 1 per cent. agar

solution [*R.A.E.*, A **27** 426] with that of seeded raisins and water for feeding adults of the Ichneumonid, *Microcryptus basizonus*, Grav. Twelve oviposition boxes [*cf.* **28** 417] were used, in six of which females of the parasite were supplied with raisins and water and in the other six with the prepared food. In order to determine whether fecundity is affected by the number of females per box, three boxes in each group contained five females each and three ten females each. Daily counts of the eggs deposited showed that the increased number of females per box did not reduce oviposition, but that the numbers of eggs were lower with the prepared food than with raisins. The totals for the 15 and 30 females given raisins were 714 and 1,342, respectively, and for those fed on the prepared food 373 and 730. The counts were terminated after 22 days, when all the females fed on the prepared food were dead, but the others would probably have laid more eggs. These results were confirmed in further experiments with six boxes each containing ten females; the 30 females supplied with raisins laid a total of 1,422 eggs in 40 days and those fed on the mixture, which were all dead by the 32nd day, only 414. Ten females given water but no food laid 134 eggs and were all dead in a fortnight, whereas ten given raisins and water deposited 616 eggs in 30 days, after which the experiment was terminated.

SWEETMAN (H. L.). **The Value of Hand Control for the Tent Caterpillars, *Malacosoma americana* Fabr. and *Malacosoma disstria* Hbn. (Lasiocampidae, Lepidoptera).**—*Canad. Ent.* **72** no. 12 pp. 245–250, 17 refs. Guelph, Ont., 1940.

The Lasiocampids, *Malacosoma americana*, F., and *M. disstria*, Hb., are widely distributed on shrubs and forest trees over most of the United States and Canada, and outbreaks occur at intervals of approximately 9–12 years. Their life-histories are similar, and both have one generation a year and overwinter in the egg stage. Since the pupal stage does not last longer than 5 weeks, the pupae are scattered and protected by thick cocoons, and the adults reproduce soon after emergence, the easiest stages to control are the eggs and larvae, which are present for 8–9 and 1–2 months, respectively. Though the eggs are attacked by a number of parasites, the percentage parasitism is low [*cf. R.A.E.*, A **27** 597]. Predators that attack the eggs are of no practical importance, but numerous larvae and pupae are destroyed by insect parasites and predators and birds, and by a wilt disease that frequently gives almost complete control of heavy outbreaks, but is of less value against light infestations. Epidemics are frequently associated with starvation conditions, caused by defoliation of the food-plants. Many larvae are also killed if warm weather in April or early May is followed by a week or more of cool weather. They can be controlled by sprays of lead arsenate applied before serious defoliation takes place [*cf.* **24** 118], but where chemical control is not economic, the collection and destruction of the eggs and especially of the larvae is effective. Nests of *M. americana* that are close to the ground are easily destroyed by rolling between the gloved hands, while those situated higher on the trees can be pulled down by means of a brush or nail-claws on the end of a pole. Larvae of *M. disstria*, though gregarious, do not form nests, but they can be destroyed when they collect on the tree trunks, which they frequently do, especially on warm days.

CHAPMAN (R. N.). **Insect Population Problems in Relation to Insect Outbreak.**—*Ecol. Monogr.* **9** no. 3 pp. 261–269, 29 refs. Durham, N.C., 1939. [Recd. 1941.]

In this introduction to a symposium on insect populations, the author briefly reviews from the literature the ecological aspects of outbreaks of insect pests. He concludes that there is a need for critical research on the fundamental problems of populations and the causes of their fluctuations and that the ecology of "outbreak pests" should be studied in advance of the outbreaks.

KING (K. M.). **Population Studies of Soil Insects.**—*Ecol. Monogr.* **9** no. 3 pp. 270–286, 32 refs. Durham, N.C., 1939. [Recd. 1941.]

The author summarises the ecological characteristics of populations of insects that live in the soil, and discusses methods of carrying out investigations on such populations and their value in forecasting outbreaks of insect pests.

EMERSON (A. E.). **Populations of Social Insects.**—*Ecol. Monogr.* **9** no. 3 pp. 287–300, 1 fig., 71 refs. Durham, N.C., 1939. [Recd. 1941.]

The complex inter-relationship of factors affecting the population dynamics of social insects is discussed, and a diagram is given illustrating those concerned in the case of a termite of the family RHINOTERMITIDAE. The factors influencing the population complex are divided into the intraspecific and interspecific societal factors, and the environmental factors, both physical and biotic. Among them, emphasis is placed on social hormones controlling the development of castes, fecundity, cannibalism, types of food, predators, nest-building and environmental control. The integrated population unit is regarded as the result of natural selection acting on the group as a whole. Both intraspecific and interspecific groups are considered as objectively real biological units.

GRAHAM (S. A.). **Forest Insect Populations.**—*Ecol. Monogr.* **9** no. 3 pp. 301–310, 12 refs. Durham, N.C., 1939. [Recd. 1941.]

Populations of insects that are economically injurious in forests may be divided into three types, *viz.*, balanced populations at high density, sporadically eruptive populations, and periodically eruptive populations. Populations that attain equilibrium at high density are relatively rare, usually occur under abnormal forest conditions and injure the trees without killing them outright. In many cases, they offer good opportunities for the application of control by natural enemies or sylvicultural practices. Insects that attain such populations on pine in the United States include *Pissodes strobi*, Peck, *Rhyacionia frustrana*, Comst., and *R. buoliana*, Schiff. Sporadic outbreaks of insects such as *Ips pini*, Say, on pine follow temporarily changed environmental conditions and, since the population returns to normal when the usual conditions are re-established, the economic importance of such outbreaks is generally slight. Periodic outbreaks are the most important economically and the most difficult to control. The most serious of such outbreaks in forests in the United States was that of *Harmologa* (*Cacoecia*) *fumiferana*, Clem., on spruce in 1910–20. Other instances are given, and factors contributing to outbreaks of forest pests and their control are discussed.

Smith (H. S.). **Insect Populations in Relation to biological Control.**—*Ecol. Monogr.* **9** no. 3 pp. 311–320, 1 fig., 9 refs. Durham, N.C., 1939. [Recd. 1941.]

After a brief consideration of the importance for biological control of the reproductive capacity of insect parasites and predators, the author analyses and discusses the ways in which their effectiveness is influenced by their ability to search for hosts and by different types of host distribution. He comments on work by Nicholson [*R.A.E.*, A **21** 369] and Nicholson & Bailey [**24** 6] and concludes that more attention should be given by entomologists to the testing of population theories.

Gooden (E. L.) & Smith (C. M.). **Measuring average Particle Diameter of Powders. An Air-permeation Apparatus.**—*Industr. Engng Chem.* Anal. Edn **12** pp. 479–482, 4 figs., 7 refs. Easton, Pa., 1940.

The following is the authors' summary : A self-calculating apparatus for direct determination of surface-weighted average particle diameter of powders has been designed and subjected to practical tests. It consists of a device for determining the average or effective particle diameter of a powder as deduced through Carman's specific surface equation [*J. Soc. chem. Ind.* **57** 225–34 ; **58** 1–7 (1938–39)] from its permeability to air when the sample is formed into a compact bed. The operation of the device is remarkably convenient, simple, and economical of both time and material. The automatic-calculating feature reduces to a minimum the work of a determination and the chances of making mistakes. In precision and accuracy the method employing this apparatus compares favourably with the usual methods of granulometric analysis for powders.

Goodhue (L. D.) & Haller (H. L.). **The non-crystalline Constituents of *Tephrosia virginiana* Roots.**—*J. Amer. chem. Soc.* **62** pp. 2520–2522, 4 refs. Easton, Pa., 1940.

The following is the authors' summary : The insecticidal constituents of *Tephrosia virginiana* have been studied further [*cf. R.A.E.*, A **21** 321 ; **24** 214]. The total chloroform extractives were divided into four fractions : rotenone, alkali-soluble portion, neutral resin and oil. A small amount of a substance melting at 76°C. was isolated from the alkali-soluble fraction. The non-crystalline material appeared to be composed largely of phenolic substances. The neutral-resin fraction yielded deguelin, which is reported for the first time as one of the constituents of this species. By adsorption on activated carbon and molecular distillation, two other compounds were isolated from this fraction in considerable quantity. One of these, melting at 131°C., has been reported by Clark [**21** 322] ; the other is an orange-yellow compound, melting point 125°C., not previously reported. The oil fraction was composed largely of liquids having the characteristics of sesquiterpenes. The remainder was a drying oil from which a small amount of semi-solid resin was removed by molecular distillation.

Sievers (A. F.), Lowman (M. S.), Russell (G. A.) & Sullivan (W. N.). **Changes in the insecticidal Value of the Roots of cultivated Devil's Shoestring,** *Tephrosia virginiana,* **at four seasonal Growth Periods.** —*Amer. J. Bot.* **27** no. 5 pp. 284–289, 1 fig., 2 refs. Burlington, Vt., 1940.

The following is the authors' summary: Clonal progenies of 10 parent plants of *Tephrosia virginiana* were grown under cultivation in north-eastern Texas to study the changes in the amount of rotenone and chloroform extractive present in the roots of such progenies and their toxicity to houseflies [*Musca domestica*, L.] at four seasonal stages of growth. Two or more of the clonal progenies of each parent were completely removed from the ground at the dormant stage (January 26), the emergence stage (March 25), the full-bloom stage (April 26) and the mature-seed stage (August 6). The roots were dried and ground, the amount of chloroform extractive and rotenone determined and the toxicity of acetone extracts tested on houseflies. The results indicate that at the full-bloom stage the roots are significantly more toxic to houseflies than at the dormant and emergence stages, but their superiority over those at the mature-seed stage is less pronounced. The chloroform extractive and rotenone content is also highest at the full-bloom stage. The toxicity of the roots of the several clonal progenies of the same parent does not vary significantly but significant differences were found in this respect between the progenies of different parents.

Searls (E. M.). **Droplet Size of Insecticides. If the Mist is too fine when sprayed, it may reduce the Effectiveness of a liquid Insecticide.** —*Soap* **17** no. 2 pp. 94–96, 1 fig., 1 ref. New York, N.Y., 1941.

This paper comprises an account of experiments noticed elsewhere [*R.A.E.*, B **29** 125], showing that an atomised spray of oil containing an insecticide may be rendered ineffective if the atomisation is too fine, since the droplets do not wet the object sprayed but are carried off in the current of air turned aside by it. A spray nozzle that gave fine but effective droplets of an insecticide in a kerosene base rendered the same insecticide ineffective in a heavy (high viscosity) oil, as it produced an aimlessly drifting mist, but the insecticide was equally effective in the heavy oil when the nozzle was adjusted to give drops similar in size to those previously obtained with the kerosene.

Lindgren (D. L.). **Factors influencing the Results of Fumigation of the California Red Scale.**—*Hilgardia* **13** no. 9 pp. 491–511, 3 figs., 16 refs. Berkeley, Calif., 1941.

The following is based largely on the author's summary. The usual method of fumigating *Citrus* in California is to apply liquid hydrocyanic acid by means of a vaporiser that rapidly diffuses the gas within the tent. A high-peak concentration is reached in a few seconds, followed by a rapid drop in concentration due mostly to tent leakage. Experiments with resistant and non-resistant strains of *Aonidiella aurantii*, Mask. [*cf. R.A.E.*, A **22** 99, etc.] showed that a high-peak type of concentration tends to be more effective than a low, uniform type of concentration in the range of dosages tried, though the differences are not great.

High mortality of the non-resistant strain was obtained with low dosages and short exposures, and there was very little difference in the mortalities given by exposures of 15, 30 and 45 minutes. Unsatisfactory results were obtained with low dosages and short exposures on the resistant strain. In 9 out of 11 cases, an exposure of 45 minutes gave slightly higher percentages of mortality of both strains than one of 30 minutes, though the differences were not statistically significant.

When preconditioned at 50°F. for 3–4 hours before fumigation, both strains showed a higher percentage mortality by fumigation than when preconditioned at 75 or 90°F. [*cf.* **23** 38]. Under laboratory conditions, non-resistant and resistant scales prefumigated with a sublethal dose of HCN one hour and just before fumigation, respectively, showed a lower percentage mortality from fumigation than those that received no prefumigation treatment. Resistant scales preconditioned at 50°F. for 3–4 hours and then prefumigated with a low dosage of HCN before the regular fumigation were more easily killed than those that were prefumigated but not preconditioned, but more insects survived than among those preconditioned at 50°F. but not prefumigated. This indicates that preconditioning at 50°F. does not overcome the effect of protective stupefaction [*cf.* **27** 343]. Preconditioning the non-resistant scales at 50°F. overcame the effects of prefumigation, and the data indicated that no protective stupefaction occurred. Of the stages of the non-resistant strain tested, the motile young are the least resistant to HCN, while the early grey adults (females at the time of fertilisation) are the most resistant. Of the stages of the resistant strain treated, the motile young are also the least resistant to HCN, while the scales in the second moult are most resistant. In both strains, as the insects pass from the early grey adult to the late grey adult (female that has been fertilised but has not produced young), they become more susceptible to fumigation with HCN.

Dickson (R. C.). **Inheritance of Resistance to Hydrocyanic Acid Fumigation in the California Red Scale.**—*Hilgardia* **13** no. 9 pp. 515–522, 2 figs., 9 refs. Berkeley, Calif., 1941.

The following is substantially the author's summary. Resistance to fumigation in *Aonidiella aurantii*, Mask., in California [*cf. R.A.E.*, A **22** 99, etc.] depends on a single gene (or group of closely linked genes) in the X-chromosome and is therefore sex-linked. Crosses were made by the mass-crossing method between resistant and non-resistant strains. Reciprocal F_1 crosses and four classes of F_2 crosses were made. These were all fumigated together with the parental strains. The F_1 females were intermediate in percentage survival between the two parental strains. The F_2 females were intermediate in percentage survival between the F_1 females and the strain to which their paternal grandmothers belonged.

Although *A. aurantii* was relatively easy to kill by fumigation with hydrocyanic acid gas in the early use of this method of control in California, its population probably contained individuals in which the resistance factor was present. Regular fumigation increased the percentage of resistant individuals in the population because of their preferential survival. With continued fumigation, the scale will become generally resistant to such control until practically all the

population is of the pure resistant strain. Once this condition is reached there should be no appreciable increase in resistance.

UDINE (E. J.) & PINCKNEY (J. S.). **Some Egg Parasites of** *Oecanthus quadripunctatus* **Beut. and of a Species of** *Orchelimum*.—*Proc. Pa Acad. Sci.* **14** pp. 81–84. Harrisburg, Pa., 1940.

In view of the possibility that some of the parasites of *Mayetiola* (*Phytophaga*) *destructor*, Say, under investigation in Pennsylvania might possess alternate hosts, collections were made of nearly 6,000 eggs of the Gryllid, *Oecanthus nigricornis* var. *quadripunctatus*, Beut., from the stems of wild carrot (*Daucus carota*) in Pennsylvania, Virginia and North Carolina, and of 153 of a Tettigoniid of the genus *Orchelimum* from the same plant in Pennsylvania and Virginia. Nine species of parasites were reared from the former and four from the latter. Lists of them are given, and their distribution and frequency are discussed. The only one that also parasitises *M. destructor* was *Eupelmus allyni*, French [*cf. R.A.E.*, A **28** 238, 239], which was reared from eggs of *Oecanthus* and occurred in all three States.

MITCHELL (H. L.). **Preliminary Notes on a Method for the Prevention and Control of White Grub Infestations in Nursery Soils.**—*Black Rock For. Pap.* **1** no. 14 pp. 95–97, 6 refs. Cornwall-on-the-Hudson, N.Y., 1939. [Recd. 1941.]

In the course of investigations in 1934 in a forest nursery in New York State on factors affecting the growth of *Pinus strobus* from after-ripened seed, it was observed that seed beds treated immediately after planting in spring with a 0·8 per cent. solution of acetic acid at the rate of 1½ U.S. pints per sq. ft. of soil to control damping off remained free from larvae of *Lachnosterna* (*Phyllophaga*), whereas untreated beds contained numerous active grubs by midsummer and the seedlings were seriously damaged. The acid did not injure the seed. These results were confirmed in 1935 and 1936 with both *Pinus strobus* and *P. resinosa*. When untreated infested beds were given 1 2 applications of acetic acid in the middle of the growing season, all the larvae were destroyed, together with other insect life and earthworms, and the seedlings were not injured by the treatment. Measures recommended in the literature for the control of the larvae in nurseries are briefly reviewed.

REES (D. M.) & GAUFIN (A. R.). **The Termite Problem in Utah.**—*Bull. Univ. Utah* **30** no. 8, 7 pp., 5 figs., 4 refs. Salt Lake City, Utah, 1939. [Recd. 1941.]

The termites that occur in Utah are *Reticulitermes tibialis*, Banks, *R. tumiceps*, Banks, and *Calotermes minor*, Hagen. *R. tibialis*, which is subterranean in habit, is the commonest, and in Salt Lake City, it has been observed feeding on the roots of trees and shrubs, on stumps, logs, posts, boards, paper, etc., and in wooden parts of buildings. Control measures are briefly reviewed [*cf. R.A.E.*, A **28** 542, etc.].

Slabaugh (R. E.). **The Silverfish in a new Role.**—*Trans. Ill. Acad. Sci.* **32** no. 2 pp. 227–228, 2 refs. Springfield, Ill., 1939. [Recd. 1941.]

Numerous reports have been received of damage to rayon by *Thermobia domestica*, Pack., in the United States, and in 1937 this pest was very common in houses in towns in Illinois. The damage to rayon fabrics consists in scraped areas and irregular jagged holes. Although *T. domestica* feeds readily on pure viscose and cuprammonium rayon, it dies if fed for long on unfinished rayon alone. Some of the finishing agents used, including starch, gums and certain oils, are more attractive to it than the rayon itself. Experiment showed that the degree of attraction was inversely proportional to the amount of fatty material contained. Rayon materials containing sulphonated compounds were not very attractive.

Burks (B. D.). **The Host of another Illinois Species of *Brachymeria* (Hymenoptera).**—*Trans. Ill. Acad. Sci.* **33** no. 2 p. 208. Springfield, Ill., 1940.

In 1939, the Chalcid, *Brachymeria tegularis*, Cress., was bred from a puparium of the Tachinid, *Acemya dentata*, Coq., parasitising *Melanoplus differentialis*, Thos., in Illinois. This completes the list of hosts of the five species of *Brachymeria* that occur in Illinois [*cf. R.A.E.*, A **25** 327].

Michelbacher (A. E.). **Effect of *Bathyplectes curculionis* on the Alfalfa-Weevil Population in Lowland Middle California.**—*Hilgardia* **13** no. 3 pp. 81–99, 7 figs., 8 refs. Berkeley, Calif., 1940.

The Ichneumonid, *Bathyplectes curculionis*, Thoms., a larval parasite of *Hypera variabilis*, Hbst.*, was introduced into lowland central California during 1933 [*cf. R.A.E.*, A **22** 355] and 1934 and readily became established in the three different climatic areas in which its host occurs. These are the San Francisco Bay area, which has a cool, moderate climate, the north-western portion of the San Joaquin Valley, which is dry and hot, and Pleasanton, which has an intermediate climate. In studies during 1935–38, the rate of parasitism in these areas was determined by collecting last-instar larvae of the weevil and rearing the parasites in the laboratory. Two series of 100 sweeps were made with an insect net in each field, and the average number of larvae and adults collected per 100 sweeps was used as a population index for *H. variabilis*.

The highest population of weevil larvae occurs between the end of March and the beginning of May, generally on the first crop of lucerne, but sometimes on the second or even later crops. Weevil activity begins early in the growing season, and larvae of a second generation are generally present during the latter part of June and throughout

* The author uses the name *H. postica*, Gylh., for this weevil, on the ground that *H. variabilis*, Hbst., is preoccupied. We are informed by Sir Guy A. K. Marshall, however, that he is applying to the International Commission on Zoological Nomenclature for the retention of *H. variabilis*, Hbst., as a *nomen conservandum*. Until the result of his application is known, therefore, the use of the name *H. variabilis* will be continued in this *Review*.—Ed.

July [*cf.* **23** 29], maximum infestation by them occurring on the third or sometimes on the fourth crop of lucerne. Adults of *Bathyplectes* begin to emerge from overwintered cocoons during January and may continue to do so through March, depending on weather conditions. They oviposit in the first-generation host larvae, giving rise to both long- and short-cycle forms. The former spin thick cocoons, in which they apparently overwinter, and the latter lighter ones, from which the adults emerge after a short time. Both kinds of cocoons were usually obtained throughout the season from collections of parasitised larvae; the numbers of overwintering cocoons were fairly large at the beginning of the season, but decreased until April, after which they rapidly increased, until by the end of May, most of the parasites were overwintering forms. The hotter climate of the San Joaquin Valley tends to cause the production of a greater proportion of overwintering forms. In the cooler parts of the infested areas of lowland central California, the parasite is able to continue activity throughout the growing season. The most active period ranges from the early season until about the beginning of July; for summer and autumn activity to be noticeable, a certain host density and a cool climate are apparently necessary.

The data obtained on the percentage parasitism and the population trends of *H. variabilis* in the seasons 1933-38 are shown on graphs for the three regions studied, from which it is evident that the San Joaquin Valley is less suited to the parasite than are the cooler areas. In general, the percentage parasitism increases at first in spring, but decreases after the last period of rapid host increase. This decrease is arrested by either the cutting of the first crop of lucerne or the emergence of the short-cycle adults. There is then an abrupt increase in the percentage parasitism, which rises to almost 100 in larvae on the second crop of lucerne and remains at this level for a considerable time, after which it falls sharply, sometimes to zero.

The final effect of *B. curculionis* on the population of *H. variabilis* cannot be predicted, but it seems that it will exert a marked controlling influence in the cooler infested areas; favourable factors are the ease with which it finds its host, the percentage of hosts accessible to attack, its high rate of increase and its power of rapid dissemination.

MICHELBACHER (A. E.) & LEIGHLY (J.). **The apparent climatic Limitations of the Alfalfa Weevil in California.**—*Hilgardia* **13** no. 3 pp. 101–139, 11 figs., 22 refs. Berkeley, Calif., 1940.

The following is based on the authors' summary. As *Hypera variabilis*, Hbst. (*postica*, Gyll.) has failed to spread readily over a continuous area of lucerne into the hotter parts of the San Joaquin Valley since it was first observed in lowland central California in 1932, it is considered that it is encountering a climatic barrier. From observations and studies made throughout the world where the weevil occurs, it appears that high temperature causes the adults to aestivate and also retards or inhibits the maturing of the sexual organs. The temperature range favourable for sexual development appears to be between 10 and 25°C. (50 and 77°F.). On the basis of this range, the portion or portions of the year favourable to activity of the adults are plotted for stations in the United States and in parts of the Old World in which the weevil is known to occur. It was found to exist in areas

having four distinct types of climate, *viz.*, those in which temperatures favourable to adult activity obtain throughout the year and those in which, owing to cold winters, hot summers or both, there are interruptions in adult activity. Areas in which a winter interruption occurs are divided into those in which it is short and those in which it is long. In climates of the latter type, in which the principal adverse factor is low winter temperature, the weevil is very destructive, as the short growing season brings about a mass attack on lucerne. Climates of this type are characteristic of the intermountain region of the United States, which includes north-eastern California. In climates in which the winter interruption is short, the adults are active early in the year, and there is time for one full generation and at least a partial second before midsummer. This climate occurs in the coastal valleys north of southern California, in the lower extremities of the San Joaquin and Sacramento valleys and along the coast of the northern half of the State. Areas in which both a winter and a summer interruption occur are divided into those having cold winters and those with relatively mild winters. The former are represented by the continental stations in the Old World, where the weevil is destructive because of mass feeding of the larvae and the factor that limits it is cold and severe winters. In areas with mild winters, the limiting factor is high summer temperatures, as is also the case in climates with a summer interruption but no winter one.

Records of the distribution of *H. variabilis* in the hotter parts of its range in the Old World indicates that it could adapt itself to almost all the climates of California, even the hot Californian deserts. It is suggested, however, that these records actually refer to the closely related *H. brunneipennis*, Boh., a species that is adapted to hot climates and has recently been found near Yuma, Arizona, and the adjacent part of California [*cf. R.A.E.*, A **28** 620, etc.]. The behaviour of *H. variabilis* in California and the lack of reported damage in places such as Italy indicate that it will not be able to survive in the hotter parts of California. It is stated in a footnote, however, that, after the paper went to press, specimens of *H. variabilis* were received from several localities in Palestine and also from Tunisia, so that there is little doubt that it occurs throughout the cooler regions of northern Africa.

CHRISTENSON (L. D.). **Insect Vectors in Relation to Quarantine, Eradication, and Control of Plant Viruses.**—*J. econ. Ent.* **33** no. 6 pp. 827–830, 7 refs. Menasha, Wis., 1940.

The author points out that in cases in which a plant virus is transmitted by insects or by insects and other means, control or eradication of the virus must include that of the vectors; control of the latter must be more effective than is usually necessary in the case of insect pests, since the survival of relatively few individuals may result in further outbreaks and spread of the disease. Quarantine regulations affecting the movement of plant material should be considered in relation to the insect vectors as well as to the virus. A list is given of some vectors and plant viruses transmitted by them that do not yet occur in the continental United States, and reference is made to work in progress there on the possibility that insects transmit the virus of peach mosaic.

PYENSON (L.). **The Cotton Leaf Worm in the Western Hemisphere.**—*J. econ. Ent.* **33** no. 6 pp. 830–833, 1 fig., 7 refs. Menasha, Wis., 1940.

The author records and discusses data on the occurrence of *Alabama argillacea*, Hb., on cotton, based on his own observations in Pernambuco, Brazil, in 1936–37 and on reports from other parts of South America, where the moths responsible for initial spring infestations in the United States are believed to originate. In some favourable environments, where food is available throughout the year, the Noctuid breeds continuously, and no evidence of diapause during unfavourable conditions has been obtained. Directional migration has not been observed, but prevailing winds may affect the movement of the moths. Wild tree cotton, which is leafless during the dry season, is very abundant in the interior of South America, and since the rainy season varies greatly in different regions, a continual supply of food is available. The migrations appear to follow closely the advent of the rainy seasons, and the period of heaviest infestation in north-eastern Brazil and Peru (April-June) coincides with the period of initial infestations in the southern United States. Records of the occurrence of the moths in New York State in late May 1937 indicated the great distances they can cover, since these moths had probably come from the same regions as those that caused the initial infestation in Texas.

ALBRECHT (H. R.). **Species and Variety Differences in Resistance to Aphid Injury in Vetch.**—*J. econ. Ent.* **33** no. 6 pp. 833–834. Menasha, Wis., 1940.

The following is substantially the author's summary. Species and varieties of vetch (*Vicia*) grown at Auburn, Alabama, in 1937–39 differed considerably in the reaction of their foliage to injury resulting from attack by *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.). An evaluation of the vetches under observation is given. Field observations and tests with caged plants showed that the inflorescences and green pods of both the resistant and the susceptible vetches could be severely damaged by the Aphid. It is probable that this injury limited the seed production of the vetches studied.

ALLEN (N.) & SHANDS (W. A.). **Tests with Benzene, Paradichlorobenzene and other Insecticides against the Tobacco Flea Beetle, *Epitrix parvula* (F.), in Plant Beds.** -*J. econ. Ent.* **33** no. 6 pp. 834–840, 3 figs., 7 refs. Menasha, Wis., 1940.

An account is given of experiments in North and South Carolina in 1938 and 1939 showing that treatment with paradichlorobenzene of tobacco plant-beds covered with canvas at night does not give adequate control of *Epitrix parvula*, F. [*R.A.E.*, A **28** 650]. Similar treatment with benzene was even less effective. Experiments with other insecticides [**28** 648, 650] are also described.

ARANT (F. S.). **A Progress Report on the Use of Rotenone Dusts for the Control of the Pickleworm and the Melonworm in Alabama.**—*J. econ. Ent.* **33** no. 6 pp. 840–843, 3 figs., 3 refs. Menasha, Wis., 1940.

The following is based on the author's summary. Dusts of derris and talc containing 1 per cent. rotenone were effective in controlling

Diaphania nitidalis, Stoll, and *D. hyalinata*, L., on cucurbits in small field plots in Alabama in 1938–39; the control varied from 83 to 100 per cent. in cantaloupes and from 89 to 100 per cent. in squash. A derris dust containing 25 per cent. sulphur was effective against these Pyralids, but caused such severe scorching to cantaloupe foliage that an average of only 2·2 ripe edible fruits per 10 hills was produced, as compared with 3·1 on the control plots and approximately 31 on plants dusted with derris and talc. Derris dusts containing 0·5 per cent. rotenone, were less effective than dusts containing 1 per cent. rotenone. In a comparative experiment with dusts containing 1 per cent. rotenone, cubé appeared to be slightly inferior to timbo and derris, but all three materials gave satisfactory control. Heavy applications of dusts were made, approximately 15–30 lb. per acre, and no attempt was made to determine the minimum effective rate of application.

Bissell (T. L.). **Curculionidae, Bruchidae, Lepidoptera, and their Parasites, infesting the Seed Pods of Cowpea and various wild Plants.**—*J. econ. Ent.* **33** no. 6 pp. 844–847, 1 fig., 5 refs. Menasha, Wis., 1940.

The results are given of further investigations on the food-plants of *Chalcodermus aeneus*, Boh. [*cf. R.A.E.*, A **27** 76], which were carried out in central Georgia in 1938 and 1939. Records of other insects obtained in the course of the work, almost all from the pods of leguminous plants, are included. Various species of wild legumes, including *Strophostyles umbellata* and *S. helvola*, were planted in uniform plots for observations on growth and insect infestation. *C. aeneus* was four times as numerous in the pods of *S. umbellata*, most of which contained one larva, as in those of *S. helvola*. It was parasitised on cowpea by *Myiophasia globosa*, Tns., *Triaspis curculionis* var. *rufus*, Riley, an undescribed species of *Triaspis*, *Microbracon mellitor*, Say, and *Eurytoma tylodermatis*, Ashm., and on *Strophostyles* spp. by *Zatropis incertus*, Ashm.

Dohanian (S. M.). *Melissopus latiferreanus* **as a Pest of Filberts in the Northwest.**—*J. econ. Ent.* **33** no. 6 pp. 852–856, 5 refs. Menasha, Wis., 1940.

The yield of filberts (*Corylus avellana*), the cultivation of which in the north-western United States is rapidly expanding, is seriously reduced by *Cydia* (*Melissopus*) *latiferreana*, Wlsm. The moth is widely distributed in the United States, and, though of chief importance as a pest of filberts, it attacks a variety of food-plants [*cf. R.A.E.*, A **20** 585; **28** 573], including apricot, peach, chestnut and *Citrus*. The larvae feed in the kernels of the filberts and cause many of the nuts to drop prematurely during August and early September; in addition to this direct damage, considerable expense is incurred in sorting infested nuts from sound ones. The eggs are laid singly on or near the nuts, and hatch in 8–11 days. The larvae enter the nuts and mature in 3 weeks, overwintering in cocoons in the nuts or on the ground. Pupation takes place between early May and late August, and the adults emerge 2–5 weeks later. In Washington and Oregon, there is one complete generation a year and a partial second. Parasites bred from the larvae comprised *Ephialtes* (*Calliephialtes*) *nucicola*,

Cushm., and *Lissonota* sp., from Oregon and California, *Elachertus evetriae*, Gir., *Macrocentrus ancylivorus*, Rohw., and *Phanerotoma tibialis*, Hald., from Oregon, and *Microdus* (*Bassus*) *nucicola*, Mues., from Oregon, Washington and California, while a single individual of *Phorocera* sp., probably *P. erecta*, Coq., was bred from a pupa collected as a larva in Oregon.

Richardson (C. H.) & Seiferle (E. J.). **Barium Compounds as Poisons in Firebrat Baits.**—*J. econ. Ent.* **33** no. 6 pp. 857–861, 1 fig., 19 refs. Menasha, Wis., 1940.

The following is based on the authors' summary. Baits containing 26 barium compounds at concentrations of 4 per cent. were tested for toxicity to *Thermobia domestica*, Pack., in Iowa in 1938. The insects were allowed to feed at will, and observations for mortality were made after 24, 48, 72 and 96 hours. Seventeen compounds, including some of very high and some of low solubility in water, were not toxic or produced mortalities of less than 25 per cent. in 96 hours. Barium sulphide was so repellent that little of the bait containing it was eaten. Undetected differences in bait consumption may explain some of the observed differences in mortality. The five most toxic compounds, in order of effectiveness based on mortality in 96 hours, were barium fluosilicate and barium carbonate; barium oxalate; and barium peroxide and barium triphosphate. The difference between the last two groups may not be significant. Barium carbonate produced approximately the same mortality as sodium fluoride at concentrations of 4 and 8 per cent., and had little if any repellent effect, whereas sodium fluoride rendered the bait noticeably repellent. No significant difference in mortality was observed between the sexes. A bait recommended for use in dwellings and other places infested by *T. domestica* consists of 86 per cent. finely-ground rolled oats, 5 per cent. confectioners' powdered sugar, 2 per cent. powdered table salt and 7 per cent. barium carbonate.

Graham (L. T.) & Richardson (C. H.). **Calcium Arsenate and Lead Arsenate Sprays with Soybean Flour for Codling Moth Control.**—*J. econ. Ent.* **33** no. 6 pp. 862–865, 1 fig., 15 refs. Menasha, Wis., 1940.

The results are given of tests carried out in Iowa in 1939 to compare the effectiveness of sprays of lead arsenate and calcium arsenate against the codling moth [*Cydia pomonella*, L.] on apple. The trees were treated uniformly up to and including the calyx spray and then received four first-brood and two second-brood cover sprays containing 3 lb. lead or calcium arsenate and 3 lb. hydrated lime per 100 U.S. gals. water with or without the addition of 12 oz. soy-bean flour; 1 lb. ferrous sulphate was added as a safener to the sprays containing calcium arsenate. The results showed that sprays of calcium arsenate with ferrous sulphate, which did not injure apple foliage, may generally be relied on to control the first generation of *C. pomonella* in Iowa, though lead arsenate is somewhat more reliable against heavy first-brood infestations and moderate or heavy second-brood infestations. The addition of soy-bean flour had no effect on the efficiency of either lead or calcium arsenate.

The rate of increase of infestation by *C. pomonella* in the experimental plots as based on the percentage of injured apples was found to follow a geometric progression.

ECKERT (J. E.). **The Toxicity of Tartar Emetic to the Honeybee.**—*J. econ. Ent.* **33** no. 6 pp. 872–875, 1 fig., 8 refs. Menasha, Wis., 1940.

Since the sprays containing tartar emetic (potassium antimony tartrate) and sugar used in California for the control of *Scirtothrips citri*, Moult., on *Citrus* [*cf. R.A.E.*, A **27** 425 ; **29** 296] are a possible source of danger to honey-bees, particularly if they are applied when the trees are in flower or at higher concentrations than is necessary, tests were carried out in the laboratory to determine the effect of tartar emetic on bees and the attractiveness to them of sugar solutions containing it. A 20 per cent. sugar solution containing tartar emetic at a rate equivalent to 1 lb. per 100 U.S. gals. was quite toxic, the minimum lethal dose of tartar emetic being between 3 and 6 micrograms per bee. A much higher concentration of tartar emetic is used on *Citrus* with a lower concentration of sugar, and since the bees were not attracted to such a dilute sugar solution, it is considered that there is little danger if the spray is applied at the concentrations recommended and after most of the petals have fallen from the orange trees. Its application during the extended blooming period of lemons cannot be avoided. No loss of bees from colonies near treated groves was recorded during 1940. The use of dusts of tartar emetic on *Citrus* or deciduous fruit trees might be more destructive, particularly if the dust was allowed to drift to adjacent pollen plants or cover crops.

HOSKINS (W. M.), BLOXHAM (H. P.) & VAN ESS (M. W.). **The insecticidal Effects of organic Compounds. I. Toxicity of Sulfur and Nitrogen Compounds to Fleshfly Larvae.**—*J. econ. Ent.* **33** no. 6 pp. 875–881, 15 refs. Menasha, Wis., 1940.

Some of the difficulties of testing the toxic effect of organic compounds on insects and interpreting the data obtained are pointed out, and it is suggested that *Lucilia sericata*, Mg., is suitable as a standard test insect, since it is easily reared under standardised conditions and has a low rate of natural mortality and a short life-cycle, while chemicals can be tested in various ways on all stages. In the experiments described in this paper, larvae were transferred during the second instar from fish-heads to a synthetic food consisting of 3 gm. each of technical powdered casein, dried brewers' yeast and butter, 14·4 cc. of a 1 per cent. agar solution, and the desired quantity of the chemical to be tested. The disadvantages of using these larvae are that they are almost completely embedded in their food, so that the poison may act by contact as well as by absorption from the gut, and also as a fumigant if it is appreciably volatile, and that their feeding alters the pH of the food, probably changing the solubility and stability of many of the compounds and affecting the ease of penetration through the integument.

The results of feeding tests with representatives from several series of organic compounds containing amino nitrogen, sulphur or both are summarised as follows : Di- and trialiphatic amines are more toxic than the monoamines, but the reverse relation holds with the

aromatic amines. Mercaptans and monosulphides are relatively non-toxic. Disulphides are more toxic than monosulphides. The group —C (=S) NH— gives rise to highly toxic compounds, especially thiourea, certain of its derivatives and certain thioamides. Introduction of a phenyl group upon the nitrogen reduces toxicity. Substitution upon the sulphur atom reduces the toxic effect. Since thiourea has little toxicity to leaf-eating insects, but is very effective against *Lucilia* larvae and those of clothes moths, it may be that the mechanism of its poisonous action is to be sought in the behaviour of the enzymes concerned in the metabolism of a highly proteinaceous diet.

Brindley (T. A.), Hinman (F. G.) & Fisher (R. A.). **Experiments with Derris and Cubé Dusts for Pea Weevil Control.**—*J. econ. Ent.* **33** no. 6 pp. 881–886, 3 figs., 2 refs. Menasha, Wis., 1940.

The following is substantially the authors' summary of work carried out in Idaho in 1934–39. Experiments in the laboratory and in field plots demonstrated that *Bruchus pisorum*, L., can be controlled in green peas and in dry peas by derris dust mixtures with a rotenone content ranging from 0·5 to 1 per cent. Large-scale field tests demonstrated that dust mixtures containing either 0·75 or 1 per cent. rotenone derived from derris, cubé or timbo, at rates ranging from 25 to 40 lb. per acre, gave satisfactory control [*cf. R.A.E.*, A **27** 325]. No significant difference could be detected between the performance of the two dilutions of the mixture. The use of a hood or a short trailing canvas on the dusting machine increased the efficiency of the treatment by preventing excessive wind drift. When the Bruchids continued to migrate from hibernation quarters to pea fields after the first application of dust, two and sometimes three applications were necessary. Satisfactory control was obtained only when all infested parts of the fields were treated.

Bohart (R. M.). **Studies on the Biology and Control of Sod Webworms in California.**—*J. econ. Ent.* **33** no. 6 pp. 886–890, 1 fig., 9 refs. Menasha, Wis., 1940.

The following is substantially the author's summary. The two species of sod webworms known to damage lawns in California are *Crambus bonifatellus*, Hulst, and *C. sperryellus*, Klots. Their life-cycle lasts six weeks or less in warm weather, and four generations are normally completed in a year. *C. bonifatellus* occurs especially along the coast, and *C. sperryellus* predominates in the drier inland valleys. Lawns of blue grass [*Poa*] and bent grass [*Agrostis*] are favoured.

Temporary control was obtained by the use of sprays containing pyrethrum extract, derris extract and dichloroethyl ether, but none of these treatments prevented reinfestation in three or four weeks. It was therefore necessary to repeat the treatment from one to three times during the summer. Lead arsenate, used at the rate of 5 lb. per 1,000 sq. ft. in 50 U.S. gals. water with 2 lb. white flour added as an adhesive, gave excellent temporary control and retained its effectiveness throughout the season under most conditions. Where watering is done every day, it may be necessary in some cases to make two applications a month apart, using 10 lb. lead arsenate and 4 lb. flour per 1,000 sq. ft.

YOTHERS (M. A.). **Females of the San José Scale rendered unproductive by Lime-sulfur.**—*J. econ. Ent.* **33** no. 6 pp. 890–892, 7 refs. Menasha, Wis., 1940.

Details are given of observations and experiments carried out in 1925–29 on the sterility of females of *Aspidiotus perniciosus*, Comst., that survive spraying with lime-sulphur during the dormant period [*cf. R.A.E.*, A **18** 70]. It was found that females from sprayed trees had either not been fertilised or had in some way been rendered sterile by the action of the spray. Microscopic examination of the reproductive organs revealed no deleterious effects of the spray. In 1925, 1927 and 1929, scales sprayed in March with lime-sulphur (3–4°Bé.) survived in considerable numbers. Some males developed to the adult winged stage, but they all died by about the middle of May without being able to emerge. Females lived and developed throughout the season until the middle of September, but none reproduced. In a series of tests, begun in the middle of May 1929, unfertilised females caged without males did not produce young or contain embryos by 27th June, when most of them were still alive, whereas when they were caged with males, crawlers were present by 12th June and were numerous by 27th June ; no males emerged from an infested twig after it was sprayed, though they had been emerging before, and the females that matured did not reproduce ; and males from an unsprayed twig from which all females were removed and which was tied to a young pear tree close to sprayed scales failed to fertilise the sprayed females, possibly because they did not find them, because the females could not be fertilised or because the spray was repellent or lethal to the males. It is concluded that the unproductivity of females of *A. perniciosus* on trees sprayed with lime-sulphur may be due to the action of the spray on the generative organs, but is more probably due to the lack of fertilisation owing to the death of the males. In the north-western United States, fertilisation in the autumn is probably rare, if it occurs at all, since females not fertilised in the spring were invariably sterile.

MICHELBACHER (A. E.). **Further Notes on *Bathyplectes curculionis* and the Alfalfa Weevil in Lowland Middle California.**—*J. econ. Ent.* **33** no. 6 pp. 892–895, 1 fig., 2 refs. Menasha, Wis., 1940.

Investigations on the influence of the larval parasite, *Bathyplectes curculionis*, Thoms., on the population of *Hypera variabilis*, Hbst. (*postica*, Gylh.) in three climatically different regions in lowland central California [*cf. R.A.E.*, A **29** 000] were continued in 1939, when the parasitism trends substantiated the results of the previous work. Since the introduction of the Ichneumonid, the heaviest population density of *H. variabilis* appears to have moved to the San Joaquin Valley from Pleasanton and the San Francisco Bay area, where the physical environment is much more favourable for its development, owing to the fact that the latter regions are even more favourable to the development of the parasite, which is so effective there that the weevil is unable to maintain any appreciable population. During surveys in the coastal area south of San Francisco Bay, where the climate is extremely favourable to both insects, one adult of the weevil and eight of the parasite were taken to the south of the known infested region, two of the parasites being recovered 60 miles from it. If the recovery of the parasite indicates the presence of the host, *H. variabilis*

must have spread over at least this distance, and have been so effectively parasitised as to remain unnoticed.

Up to the present time, *B. curculionis* has given remarkably good control of *H. variabilis* in the cooler infested regions, but seven individuals of a species of *Eupteromalus* were bred from cocoons collected in lucerne fields in April 1940 [*cf.* **23** 654], and this hyperparasite may reduce its effectiveness.

Swain (A. F.) & Buckner (R. P.). **Hydrocyanic Acid Dosages in Relation to Control by Fumigation of Red Scale** *Aonidiella aurantii* (**Mask.**) **on** *Citrus*.—*J. econ. Ent.* **33** no. 6 pp. 895–900, 3 figs., 3 refs. Menasha, Wis., 1940.

The control of *Aonidiella aurantii*, Mask., on *Citrus*, particularly lemons, in California has become increasingly difficult during the last 25 years, chiefly on account of the appearance and spread of the strain of this Coccid that is resistant to hydrocyanic acid gas [*cf. R.A.E.*, A **27** 342, etc.]. Under conditions most favourable for scale growth and reproduction, fumigation with the standard dosages every 6–8 months has been necessary, and experiments were, therefore, carried out on lemon in the autumn and winter of 1935–36 to determine the most economical dosage for control of the resistant strain. About 2,500 trees were fumigated at dosages ranging from 14 to 26 cc. HCN per unit (100 cu. ft. in the case of average-sized trees), and mortality counts of mature scales were made. From these results, a dosage-mortality curve was obtained for dosages of 10–60 cc. per unit, and from consideration of this and the cost-efficiency factor, it was calculated that the most economical dosage would be about 40–42 cc. per unit. This theoretical figure does not allow for the differences in susceptibility of the Coccid at different seasons of the year and in different stages of development and would vary somewhat with the relative costs of tent coverage and HCN, but it indicates that the most economical dosage is much larger than those in general use.

In further tests, carried out in 1937–39 with different dosages, chiefly 24 and 28 cc. per unit, in a number of lemon groves in southern California that varied in intensity of infestation and in the degree of resistance of the scales, fumigation at a dosage of 24 cc. reduced the non-resistant strain in a heavily infested orchard so much that it was two years before noticeable numbers reappeared ; higher dosages did not appear to have any added value, although they gave lower infestations a year after treatment. Dosages of 28 cc. were significantly more effective than those of 24 cc. in orchards infested with the resistant strain. The conclusion that dosages higher than those normally used are advisable if the resistant strain is prevalent in lemon orchards is confirmed by observations of commercial fumigation. Where the resistant strain forms only a small proportion of the population or is absent and fumigation at 24 cc. controls the infestation for two years, a higher dosage appears to have no added value. Fumigation of lemons with high dosages of HCN should be carried out only in the winter months or injury to the trees or fruit may occur.

Ebeling (W.). **A Method for Determination of Oil-spray Residue on** *Citrus* **Foliage.**—*J. econ. Ent.* **33** no. 6 pp. 900–904, 6 figs., 4 refs. Menasha, Wis., 1940.

The following is based on the author's summary. A modification of Ebeling's method [*R.A.E.*, A **28** 617] is described by which the

oil-spray residue on *Citrus* leaves sprayed in the laboratory is determined by a simple and rapid technique involving the absorption of the oil from the upper surfaces of the leaves with filter paper and the subsequent extraction of the oil from the paper. The oil deposit was found to be directly proportional to the oil concentration. Blood albumin spreader added at the concentration at which it is ordinarily used (4 oz. per 100 U.S. gals. spray) to a heavy-medium oil tank-mixed spray was found to decrease the oil deposit on *Citrus* for any given percentage of oil, but it may increase the deposit of emulsive oils containing oil-soluble emulsifiers or of oils with a low unsulphonatable residue. Certain electrolytes, such as calcium chloride and aluminium sulphate, were found to increase the oil deposit.

McCall (G. L.) & Kagy (J. F.). **A colorimetric Method for the Determination of Oil Deposit on *Citrus* Leaves.**—*J. econ. Ent.* **33** no. 6 pp. 905–908, 12 refs. Menasha, Wis., 1940.

The following is based on the authors' summary. By the method described, which is rapid, simple and accurate and can be used over a wide range of oil concentrations, the spray oil is stained with Sudan III. After the dyed oil has been sprayed as an emulsion, the deposited oil is washed from the leaves with a highly refined light distillate oil or odourless kerosene, found to be a satisfactory solvent for removing the spray oil from the upper surface of *Citrus* leaves. The amount of oil deposited is determined by comparing the colour intensity of the unknowns with a set of colour standards prepared from the dyed spray oil in question.

The recovery of oil from leaves by the use of this method averages 98·41 per cent., and the laboratory oil-deposit determinations show an average co-efficient of variation of 5·38 per cent. The standard error, in percentage of the mean, varies from 1·83 to 3·07. An amount of oil as low as 19 mg. was determined from a sample of 25 leaves. Plant waxes and essential oils do not appear to affect the accuracy of the method.

Webster (R. L.), Marshall (James) & Fallscheer (H.). **The present Status of Organic Insecticides for Codling Moth Control.**—*J. econ. Ent.* **33** no. 6 pp. 909–912, 1 ref. Menasha, Wis., 1940.

Investigations carried out from 1932 to 1939, inclusive, on the use of organic insecticides for the control of the codling moth [*Cydia pomonella*, L.] on apple in Washington State are summarised. Most of the work was concerned with the use of nicotine compounds, but conditions of severe infestation, such as prevail in central Washington, render it necessary to maintain an unusually high coverage throughout the season. This leads to abnormally high costs, which are not offset by freedom from residue removal. A high degree of efficiency may be obtained, however, lead residue eliminated, and comparative freedom from foliage and fruit injury obtained by the use of nicotine. The application in cover sprays of various pyrethrum extracts, usually combined with mineral oil, was not encouraging. Phenothiazine [thiodiphenylamine] was tested in 1936 and in combination with stove oil in 1939, but was relatively ineffective. A proprietary organic compound known as Genicide, in which the active insecticidal agent is a diphenylene ketone oxide known as xanthone, was tried in 1939.

It was applied to two plots in eight cover sprays at the rate of 2 lb. per 100 U.S. gals. water with 1 lb. of a proprietary soap and $\frac{3}{4}$ lb. hydrated lime and resulted in 16·8 and 11·5 per cent. infested fruit, respectively. The percentages of infested fruit on two plots on which it was used with stove oil were only 9·4 and 9·9. No adequate control plots were available, but a neighbouring block of trees that was sprayed with lead arsenate and oil, followed by cryolite, had 47·6 per cent. of the fruit infested.

Galloway (A. G.) & Burgess (A. F.). **An improved Method of applying insecticidal Dusts.**—*J. econ. Ent.* **33** no. 6 pp. 912-915, 1 fig. Menasha, Wis., 1940.

The authors describe an apparatus for dispersing insecticidal dusts with liquid adhesives so that a uniform, controlled dispersion rate can be maintained under varied conditions, and adherence of the finely divided dust particles to the foliage can be obtained. The apparatus can be adapted for use in aircraft or ground equipment. The dust materials are dispersed in measured quantities, and simultaneously, but separately, liquids, such as adhesives, emulsions and water, are released in such a manner that they coat the dust particles. This coating process occurs outside the apparatus and in such a way that liquid particles unite with a large proportion of the dust particles, thus avoiding clogging or fouling of the apparatus. The elimination of water as a carrier substantially increases the amount of insecticide that can be transported in mobile equipment. Following satisfactory preliminary field tests in 1937, in which the apparatus was mounted on a light motor truck, it was tested on an autogiro in 1938 and again in 1939, when a mixture of lead arsenate and oil was applied in June to woodland in Massachusetts infested with the gipsy moth [*Lymantria dispar*, L.] and resulted in a considerable reduction in the number of egg-clusters.

Pearce (G. W.) & Avens (A. W.). **The Ratio of Lead to Arsenic in Spray Residues from Lead Arsenate. II.**—*J. econ. Ent.* **33** no. 6 pp. 918–920, 5 refs. Menasha, Wis., 1940.

In view of work by Fahey & Rusk [*R.A.E.*, A **27** 539], the authors reinvestigated the effect of weathering on the ratio of lead to arsenious oxide in lead-arsenate residues on apples [*cf.* **27** 139]. The ratios were determined 1, 21 and 70 days after spraying with lead arsenate in New York in 1939, and the following conclusions are drawn. No changes in the ratio of lead to arsenious oxide in spray residues from lead arsenate alone were observed. The addition of lime to lead-arsenate sprays produces conditions that tend to result in an increase in the ratio after weathering. The presence of materials such as Bordeaux mixture, Coposil [copper ammonium silicate] and aluminium sulphate, which can act as arsenical injury correctives, tends to suppress any changes in the lead-arsenate spray deposits brought about by lime or other materials. Oil sprays applied with or following lead-arsenate sprays also tend to suppress any changes in the composition of the residues. As the number of lead-arsenate cover sprays applied is increased, the ratio of Pb to As_2O_3 in the residues at harvest tends to approach that in di-lead arsenate.

EASTER (S. S.). **Fumigation of Sweetpotatoes with Methyl Bromide for Control of the Sweetpotato Weevil.**—*J. econ. Ent.* **33** no. 6 pp. 921–926, 8 refs. Menasha, Wis., 1940.

Experiments were carried out in Louisiana from September to December in 1937 and 1938 to determine whether methyl bromide could be used, at concentrations that would require relatively short exposures, to destroy *Cylas formicarius*, F., in seed sweet potatoes without causing appreciable harm to the tubers [*cf. R.A.E.*, A **27** 539]. At reduced pressure (4 ins. mercury, increased to 5 ins. after the introduction of the fumigant), complete mortality of larvae, pupae and adults embedded in the tubers was obtained after exposure for 75 minutes to a dosage of 40 oz. per 1,000 cu. ft., and more than 99 per cent. mortality after exposures of 45 and 60 minutes. At atmospheric pressure, the same dosage gave complete mortality after 5 hours' exposure at temperatures of 67–87°F. and more than 99 per cent. after 4 hours at 70–89°F. The percentage mortality was reduced at temperatures below 70°F. An exposure of 10 hours was necessary for complete mortality with a dosage of 20 cc. per 1,000 cu. ft. at atmospheric pressure and temperatures of 74–82°F.

Methyl bromide exerts a variable deleterious physiological effect on the tubers, which may result in a considerable loss. This loss can be avoided to some extent by careful handling, partial curing and post-fumigation heating. Small-scale fumigations of seed sweet potatoes from a number of farms gave results satisfactory to the farmers. The loss was not prohibitive, and the production of plants was equal to that in the control plots or better.

The requirement of an airtight fumigation chamber and provision for post-fumigation heating may restrict the use of this fumigant to areas in which sweet potatoes are grown on a commercial scale.

EICHMANN (R. D.). **Residual Poison Sprays against the Onion Thrips on Carnations.**—*J. econ. Ent.* **33** no. 6 pp. 926–932, 2 figs., 8 refs. Menasha, Wis., 1940.

In laboratory and greenhouse tests to determine the value of the residues from poison sprays for the control of *Thrips tabaci*, Lind., on greenhouse carnations in Washington, commercial spray concentrates of pyrethrum and derris proved ineffective, and sprays of nicotine sulphate with molasses or Karaya gum and of Paris green with brown sugar, though of some value, were inferior to sprays of tartar emetic, brown sugar and water [in apparent contradiction to results already noticed (*R.A.E.*, A **27** 525)]. In the laboratory, a spray containing 4 lb. tartar emetic and 16 lb. brown sugar per 100 U.S. gals. water gave practically complete mortality when the thrips were caged on the plants immediately or up to a week after spraying, and sprays containing only ½ lb. tartar emetic and 2 lb. sugar per 100 U.S. gals. also killed all the thrips but acted more slowly. Molasses, maize syrup, sucrose and white sugar were effective substitutes for brown sugar. A number of the sprays gave similar results against *Taeniothrips simplex*, Morison, which represents about 10 per cent. of the thrips in carnation flowers in Washington. A spray of 4 lb. calcium antimony tartrate and 16 lb. brown sugar per 100 U.S. gals. water gave complete mortality of *Thrips tabaci* in two days when the thrips were not placed on the foliage until six days after spraying. The most

effective residue in the greenhouse was that from a spray containing 2 lb. tartar emetic and 4 lb. brown sugar or 1 U.S. pint blackstrap molasses per 100 U.S. gals. water, which limited the percentage of flowers damaged by thrips to 1 when applied 9 times during February–June. There was some petal injury, especially on the lighter-coloured varieties, and the residue became objectionable after too frequent applications; higher concentrations were undesirable. It is recommended that three or four weekly applications should be made in autumn, starting before the flowers appear, and again in February, followed by applications about once every three weeks until the end of the season in July.

Preliminary tests with white arsenic, sodium fluoride and mercuric chloride indicated that they might prove suitable for thrips control when combined with brown sugar or other spray adjuncts.

EYER (J. R.) & MEDLER (J. T.). **Attractiveness to Codling Moth of Substances related to those elaborated by heterofermentative Bacteria in Baits.**—*J. econ. Ent.* **33** no. 6 pp. 933–940, 11 refs. Menasha, Wis., 1940.

A bait of diluted sugar-cane syrup fermented by species of *Aerobacter* and *Aerobacillus* has been found to be more attractive to adults of *Cydia* (*Carpocapsa*) *pomonella*, L., in New Mexico than the same bait allowed to ferment through contamination by the yeast, mould and bacterial flora of the air [*cf. R.A.E.*, A **28** 221]. Analyses of bait fermented by these bacteria revealed that ethyl alcohol, acetic and lactic acids and acetyl methyl carbinol are the most prevalent of the compounds in these respective classes during the first ten days of fermentation. A review of the literature relating to the chemical products elaborated by bacteria of this type in the fermentation of sucrose, glucose and fructose suggested that homologous series of alcohols, acids and esters related to these compounds should be compared in a number of different ways. An olfactometer was used for a preliminary comparison of these organic chemicals in the laboratory, and it was found that a wide variety of alcohols, acids, esters and gases, related to those elaborated by heterofermentative bacteria in the fermentation of syrup bait, were attractive. It is therefore concluded that no one chemical is to be considered the most important factor in the chemotropic response of the moth.

HALLER (H. L.). **Insecticidal Properties of the Fruit of *Phellodendron* spp.**—*J. econ. Ent.* **33** no. 6 p. 941, 1 ref. Menasha, Wis., 1940.

An extract of the residue left after the removal of the volatile oil from the fruits of trees of the genus *Phellodendron*, which were introduced in the United States from north-eastern Asia about 80 years ago, showed considerable toxicity to the larvae of the codling moth [*Cydia pomonella*, L.] when tested by the apple-plug method [*cf. R.A.E.*, A **23** 174]. It was as toxic as a derris standard containing 5·2 per cent. rotenone to the housefly [*Musca domestica*, L.] and more toxic to mosquito larvae, but a single spray test indicated that it was relatively non-toxic to larvae of the southern armyworm [*Laphygma eridania*, Cram.]. The material is a fast-acting poison similar to pyrethrum and nicotine.

Mathers (W. G.) & Olds (H. F.). **The European Pine Shoot Moth in British Columbia.**—*J. econ. Ent.* **33** no. 6 p. 941. Menasha, Wis., 1940.

The European pine shoot moth [*Rhyacionia buoliana*, Schiff.] was first found in British Columbia about 14 years ago, when it attacked pines in a nursery in Victoria [*R.A.E.*, A **17** 318] and was intercepted on a shipment of *Pinus mugo* from Europe. The pines were destroyed, and the moth was not observed again until June 1938, when it was reported in the city of Vancouver. A preliminary survey indicated that the infestation had been in progress for at least three years. Further surveys in the spring of 1939 showed that *Pinus contorta* and *P. mugo* were infested. Almost all the infested trees were removed and burnt, but a few valuable ones were clipped, and these, together with all remaining pines in the infested area, were sprayed on 11th July with a mixture of 18 lb. lead arsenate, 5 lb. nicotine sulphate and 2½ lb. emulsified herring oil in 240 gals. water. A further survey in the spring of 1940 indicated that the infestation had been eradicated. Material bred in cages showed over 20 per cent. parasitism, the parasites recovered being 22 examples of *Ephialtes* (*Callicephialtes*) *comstocki*, Cress., 4 of *Pimpla* (*Ephialtes*) *obesa*, Cushm., 4 of *P.* (*E.*) *conquisitor*, Say, and 1 of *P.* (*E.*) *evetriae*, Vier.

Blanton (F. S.) & Haasis (F. A.). **Three additional Species of Aphids transmitting Narcissus Mosaic.**—*J. econ. Ent.* **33** no. 6 p. 942, 2 refs. Menasha, Wis., 1940.

In further experiments in New York on the transmission of narcissus mosaic by Aphids [*cf. R.A.E.*, A **27** 652], *Anuraphis roseus*, Baker, from apple, *Myzus cerasi*, F., from cherry and *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.), from vetch [*Vicia*], transmitted the virus from diseased narcissus to 13 of 18, 15 of 36 and 24 of 31 plants, respectively. These three Aphids cannot survive long or establish colonies on narcissus, but *A. roseus* and *M. onobrychis* have been recorded from it.

Martin (C. H.). **A portable Dusting Tent.**—*J. econ. Ent.* **33** no. 6 pp. 942–943, 3 figs. Menasha, Wis., 1940.

The author describes a portable tent, resembling the top of a covered wagon and large enough to cover five tomato plants, used in dusting tests carried out on small plots to prevent the confusion of results caused by the drifting of the insecticide from one plot to another.

Smith (R. H.). **Establishment of the Codling Moth on Stone Fruits in California.**—*J. econ. Ent.* **33** no. 6 p. 944, 3 refs. Menasha, Wis., 1940.

The codling moth [*Cydia pomonella*, L.], which was recorded in 1929 as maintaining itself on stone fruits in southern California independently of its usual food-plants [*R.A.E.*, A **17** 520], has become increasingly destructive in commercial plum orchards in the Pomona district in the last ten years. It was a serious pest of plum and apricot in South Africa some time ago [*cf.* **13** 526; **15** 20], and control measures were applied for a number of years, but recent correspondence indicates that its importance has declined. The

annual loss in some orchards in California amounted to 20 per cent. of the crop before 1933, when control measures were undertaken. The treatment was a spray of basic lead arsenate (4 lb. per 100 U.S. gals. water with a spreader) applied once at about the middle of May, when the plums had a diameter of about $\frac{1}{2}$ in. In 1938, 25 per cent. of the crop was lost in a sprayed orchard, probably owing to prolonged hatching of the larvae, and in 1939 and 1940, a second application of lead arsenate was made 3–5 weeks after the first. The annual loss in an unsprayed orchard has been about 50 per cent. of the crop in recent years. Early studies indicated that only one generation would be able to develop in a single variety of plum [*cf.* **17** 520], but two generations developed in Kelsey plums in 1934; the first matured in the green plums and emerged in June, while the second was maturing when the crop was picked in the first half of August.

Essig (E. O.). **A Seed-infesting Psocid new to North America.**—*J. econ. Ent.* **33** no. 6 p. 946, 7 refs. Menasha, Wis., 1940.

Large numbers of the Psocid, *Lepinotus patruelis*, Pearman [*cf. R.A.E.*, **19** 721] were found infesting spinach seed received in California from Holland in 1940. They appeared to feed on the particles of leaves, stems and other parts of the plants that were present as well as on the seeds, and were still thriving in mid-July, more than six weeks after the receipt of the seed by the author. All stages were present and are briefly described. It is stated in a footnote that examples of *L. patruelis* were taken in a private residence in Santa Cruz on 19th July 1940; this may indicate that the Psocid has been present in California for some time. A list is given from the literature of five species of *Lepinotus*, showing their distribution.

Flanders (S. E.). **Observations on the Biology of the Elm Leaf Beetle Parasite,** *Erynnia nitida* **R.-Desv.**—*J. econ. Ent.* **33** no. 6 pp. 947–948, 3 refs. Menasha, Wis., 1940.

Attempts have been made at intervals during the past twenty years to establish the Tachinid, *Erynnia nitida*, R.-D., in the United States for the control of the elm leaf beetle, *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.). In 1939, adults emerged between 5th and 11th May from material just received in California from France; they paired 2–3 days later, and the females began to oviposit 5 days after mating. Females may deposit over 100 eggs, since one dissected 12 days after pairing contained about 140 eggs, in each of which was a fully formed larva. Only the larvae of the host are attacked, preferably when they are nearly full-grown. Under normal conditions only one egg is deposited on a host, and the parasite larva hatches and enters the host at once. The feeding period in the host was 7 days at room temperature, and the time necessary for continuous development to the adult was about 18 days, females requiring 1 day more than males. Many of the larvae, however, remain in a diapause during the first instar until the host has become an adult. The life-cycle from egg to egg averaged about 24 days if development was continuous, and about 50 days or 6 months or more, according to whether or not the host overwintered, if there was a diapause. It is probable that the overwintering larva cannot complete its development under natural

conditions until the host has begun to feed in spring. In 1939, four generations of *Erynnia* were bred in the laboratory on host material collected in the field. Most of the larvae of each generation, except possibly the first, underwent diapause, and most of the third generation and all of the fourth overwintered. Some of the host females containing parasites in diapause oviposited.

During the spring and summer of 1939, 31 mated females of *E. nitida* were liberated in a district in California that had been infested with *G. luteola* for only a few years and was free from the pupal parasite, *Tetrastichus brevistigma*, Gah. They reproduced readily, and the parasite appeared to be well established by the same autumn. Of adults of *Galerucella* collected in the field in December 1939, about 10 per cent. were parasitised, but no parasitised adults survived the winter in an outdoor cage. A high winter mortality of parasitised beetles may have occurred in nature, since *Erynnia* was not recovered from several hundred larvae of *Galerucella* collected in June 1940 and was not observed in the field. Of hibernating adults collected in December 1940, however, about 20 per cent. were parasitised.

Several males of the native Tachinid, *Synaplomyia* (*Aplomyiopsis*) *galerucellae*, Villen. [*cf. R.A.E.*, A **21** 200], were bred from larvae of *G. luteola* collected in the same district in 1937. No females have been reared. The larvae of this Tachinid are readily distinguishable from those of *E. nitida*.

Downes (W.) & Andison (H.). **The Establishment in British Columbia of Parasites of the Holly Leaf Miner, *Phytomyza ilicis* Curtis.**— *J. econ. Ent.* **33** no. 6 pp. 948–949. Menasha, Wis., 1940.

As a result of investigations in England [*cf. R.A.E.*, A **27** 669], consignments of the Eulophids, *Chrysocharis gemma*, Wlk., and *C. syma*, Wlk., the Pteromalids, *Sphegigaster flavicornis*, Wlk., and *Cyrtogaster vulgaris*, Wlk., and the Braconid, *Opius ilicis*, Nixon, were introduced in 1936–39 into British Columbia for the control of *Phytomyza ilicis*, Curt., on English holly (*Ilex aquifolium*). The parasites were liberated in Victoria in 1936–38 and in the city of Vancouver or its vicinity in 1939, and *Chrysocharis gemma* and *O. ilicis* have definitely become established in Victoria. Examples of these two parasites and of *S. flavicornis* were also caged on infested holly branches; adults of *S. flavicornis* were recovered in 1938 from material caged in 1937, and adults of *S. flavicornis* and *C. gemma* in 1939 from material caged in 1938. All the recoveries were made in early spring. The first recovery in the field was made in 1940, when *C. gemma* was found in numbers in two holly plantations in which liberations had been made. In one of these, which was large, it was parasitising about 80 per cent. of the larvae of *Phytomyza*. *O. ilicis* was not recovered in the cage in 1938 and was believed to have died out, but it appears to have escaped, since a flourishing isolated colony was found close by in 1940. Adults of this Braconid have been observed ovipositing in or near *Phytomyza* egg-punctures; growth is completed within the host puparium, so that the mines attain full size and cannot be distinguished from those of unparasitised individuals. *C. gemma*, however, completes its growth within the larva of the host and the mine remains very small. The adults of both parasites emerge early in May at the same time as those of *P. ilicis*.

ESSIG (E. O.). **Mediterranean Flour Moth breeding in Comb of Honeybee.**—*J. econ. Ent.* **33** no. 6 pp. 949-950. Menasha, Wis., 1940.

A colony of honeybees that established itself in a chimney in California in 1939 was eliminated by fumigation with calcium cyanide, but a second appeared in the same chimney in 1940. This colony was destroyed in the same way, and a month later the Mediterranean flour moth [*Ephestia kuehniella*, Zell.] was found to be breeding freely in the honeycomb and old brood in the chimney. The moths were allowed to remain, in the hope that they would destroy all remnants of the comb and its contents and so prevent further swarms of bees from being attracted to the chimney.

SNAPP (O. I.). **Plum Curculio Adults survive low Temperatures in the South.**—*J. econ. Ent.* **33** no. 6 p. 950. Menasha, Wis., 1940.

In spite of an unusually cold period in central Georgia between 19th and 29th January 1940, when the minimum daily temperature was 9°F. on one day and 12°F. on three days and rose to 32°F. on only one day, living adults of the plum curculio [*Conotrachelus nenuphar*, Hbst.] were found in Johnson grass and Bermuda grass on 20th January, and they moved from hibernation into the peach orchards in nearly the usual numbers later. It is evident that, contrary to popular opinion, the low temperatures had little effect on the hibernating weevils, which readily survive much lower temperatures in the northern United States.

BREAKEY (E. P.), HUBER (G. A.) & BAUR (K. E.). **The Use of Calcium Cyanamid in the Control of the Pear Thrips, *Taeniothrips inconsequens* Uzel, in Prune Orchards.**—*J. econ. Ent.* **33** no. 6 pp. 950–951, 3 refs. Menasha, Wis., 1940.

The control of *Taeniothrips inconsequens*, Uzel, in prune orchards in Washington has become a major problem. The value of commercial pulverised and oiled calcium cyanamide, applied to the soil surface for the control of the overwintering thrips [*R.A.E.*, A **28** 343] was confirmed in the spring of 1940, when several acres were treated in each of three orchards by means of a power duster equipped with a hood and short apron. The percentage control obtained varied from 83 to 98, and applications of 100 and 200 lb. per acre were at least as effective as 300 lb. The lighter rates would not only be cheaper but also possibly preferable on account of the nitrogen requirements of the crop, if, owing to weather conditions, a second application was necessary to control the brown-rot fungus, *Sclerotinia fructicola*. The soil cover, which consisted of Austrian field peas, chickweed (*Stellaria media*) and vetch [*Vicia*], was badly scorched within a few days of the application of the dust, but appeared to be growing with increased vigour within two or three weeks. The period of application was one of almost daily rainfall in 1940, whereas it had been dry in 1939.

SHAW (F. R.). **A new Species of leafmining Sawfly attacking Violet.**—*J. econ. Ent.* **33** no. 6 p. 951. Menasha, Wis., 1940.

For four years, violets (*Viola papilionacea*) at the Massachusetts State College have been infested by an undescribed species of *Fenusa*. The adults were observed from 25th July to 15th August. The eggs

were deposited singly within the leaf through small slits cut in the upper epidermis and hatched in 4–6 days. The larvae fed in mines within the leaves for 22–28 days before migrating to the soil ; in 1939, soil, trash and plants were examined for pupae, but none was found.

EICHMANN (R. D.). **Corn Ear Worm hibernates in Washington State.**—*J. econ. Ent.* **33** no. 6 pp. 951–952, 1 ref. Menasha, Wis., 1940.

Heliothis armigera, Hb., is very destructive to both sweet and field maize in most sections of eastern Washington, and almost every ear of maize is infested throughout the season in the Yakima Valley, although much of the damage is confined to the tip of the ears in the varieties with long tight husks. Autumn ploughing and other methods of cultivation are effective control measures in regions where *H. armigera* hibernates [*cf. R.A.E.*, A **25** 619], and, owing to the absence of available data, investigations were carried out in two localities in 1938–39 and in two others in 1939–40 to determine whether it is able to hibernate in Washington. No emergence occurred in spring in the cages in two of the places, and only 2·38 and 1·96 per cent. of the larvae that entered the soil in the others gave rise to adults. It appeared that pupae from larvae entering the soil in September hibernated more successfully than those from larvae entering later, that lighter soils were more favourable than heavy ones, and that the percentage of emergence was not affected by considerable differences in rainfall or slight differences in temperature in the localities in which the observations were made.

CHISHOLM (R. D.). **Insecticide Stickers. Use of Rosin-mineral Emulsion as a Sticker for agricultural Insecticides.**—*Soap* **17** no. 1 pp. 113, 125, 4 refs. New York, N.Y., 1941.

Resin-residue emulsion has been successfully used for several years as an adhesive for derris [*cf. R.A.E.*, A, **24** 727], but is sometimes difficult to obtain. During the summer of 1937, investigations were made to find an adhesive that would be satisfactory and available in the regular market. The materials that fulfilled these requirements were emulsions of commercial resin oil, which would, however, probably be too expensive to use, and mixtures of resin and mineral oil, which are easily prepared at a low cost.

In laboratory tests, resin was dissolved by heat in a heavy lubricating oil (S.A.E. 40), a light lubricating oil (commonly called flushing oil), and an oil of the kerosene type. The amount of oil was adjusted to form 20, 40, 60 and 80 per cent. of the mixture. On cooling to room temperature, the mixture containing 40 per cent. light lubricating oil had physical properties somewhat similar to those of resin residue. Stock emulsions containing 50, 60, 66·6, and 75 per cent. of this mixture were prepared, with ammonium caseinate as the emulsifier. After 30 days the 66·6 and 75 per cent. emulsions became so viscous that it was difficult to dilute them, while the 50 per cent. emulsion showed a tendency to form into layers, but the 60 per cent. emulsion was uniformly stable and easily diluted with water. It is prepared by dissolving 36 lb. resin in 24 lb. light lubricating oil by means of heat, stirring to form a uniform solution and cooling to about 140°F. ;

35·2 lb. water is heated to the same temperature and 4 lb. casein (80 mesh) added, with vigorous agitation. When sufficient time has elapsed for the casein to swell, 0·8 lb. ammonium hydroxide (specific gravity 0·90) is added. As soon as the casein is dispersed, the resin solution is added slowly, with continued agitation until a cream-like emulsion is formed. This emulsion has good storage qualities and has remained stable in the laboratory for several months. Under certain conditions, the addition of a preservative might be necessary.

Laboratory and orchard spraying tests were made to compare the emulsion of resin and oil and resin-residue emulsion. The sprays contained 3 lb. derris and 3 lb. emulsion per 100 U.S. gals. water. In the laboratory, the initial deposit from the spray containing resin and oil was 15 per cent. greater than that from the spray containing the resin-residue emulsion, and after washing tests the deposit was 25 per cent. greater. In the orchard tests, the sprays were applied to peach and apple trees early in August. Observations made as soon as the residues were dry and at intervals of a few days over a period of three weeks showed that the initial amounts of derris deposited and the persistence of the deposits after heavy rain appeared to be the same for the two sprays. No spray injury was observed at any time. The emulsion of resin in oil may also be valuable for use with other insecticides ; it is prepared easily and cheaply, and the character of the emulsion can be modified to meet special conditions by changes in the type of mineral oil, the ratio of resin to mineral oil, and the kind and quantity of emulsifier.

SWEETMAN (H. L.). **Physical Ecology of the Firebrat,** *Thermobia domestica* **(Packard).**—*Ecol. Monogr.* **8** no. 2 pp. 285-311, 3 figs., 8 refs. Durham, N.C., 1938. [Recd. 1941.]

A detailed account is given of laboratory investigations on the effect of temperature and humidity on the development of *Thermobia domestica*, Pack., which is a common household pest and a general scavenger ; it feeds on many carbohydrate and protein-containing foods as well as on starchy paper and cloth. Since it tends to remain hidden during the day, much of the damage it causes to food remains unnoticed or is discovered only after much feeding has occurred. The laboratory food consisted of whole wheat flour, or a prepared cereal food, mixed with dried lean beef.

The following is based on the author's conclusions. *T. domestica* requires a high temperature and relative humidity for development. The general optimum physical environment for all stages is near 37°C. [98·6°F.] and 84 per cent. relative humidity. Under these conditions and with an ample food supply, it can become very abundant and consequently capable of causing considerable damage.

Hatching of the eggs occurs in environments ranging from 24 to 47°C. [75·2-116·6°F.] and from 12 to 100 per cent. relative humidity. The eggs can withstand exposure to temperatures below 24°C. for considerable periods and still hatch if placed in favourable environments. The length of the egg stage ranges from about 75 days at 24 to about 9-10 days at 47°C. ; under optimum conditions, it lasts 12-13 days [*cf. R.A.E.*, A **26** 224]. The nymphs will develop to maturity in environments ranging from 27 to 44°C. [80·6-111·2°F.] and from 48 to 100 per cent. relative humidity. Maturation occurs in 2 to 4 months in optimum environments. The nymphs are readily

killed by temperatures below 0°C. [32°F.] or above 44°C. The adults develop eggs and oviposit at temperatures of from 32 to 41°C. [89·6–105·8°F.] and relative humidities of from 48 to 97 per cent. The eggs are laid in crevices or hidden in food or débris. Only a few individuals can withstand temperatures above 47°C. for more than a few days. The average number of eggs per female is near 50, with wide variations in the numbers deposited by individuals. The length of life in favourable environments is about 2–2·5 years at 32°C. and about 1–1·5 years at 37°C. Oviposition at 37°C. occurs from about an age of 2 months to the end of life. Only one lot of eggs is laid during an instar and fertilisation must precede each oviposition.

Heit (C. E.) & Henry (H. K.). **Notes on the Species of White Grubs present in the Saratoga Forest Tree Nursery.**—*J. For.* **38** no. 12 pp. 944–948, 3 figs. Washington, D.C., 1940.

Lamellicorn larvae associated with injury to conifer seedlings and transplants in a forest-tree nursery in New York State, where observations on them were carried out over six years, comprised, in order of decreasing importance, *Polyphylla variolosa*, Hentz, *Lachnosterna* (*Phyllophaga*) *tristis*, F., *L.* (*P.*) *anxia*, Lec., *L.* (*P.*) *fusca*, Fröl., *Diplotaxis sordida*, Say, *Anomala* (*Pachystethus*) *lucicola*, F., *L.* (*Phyllophaga*) *gracilis*, Burm., *L.* (*P.*) *crenulata*, Fröl., *L.* (*P.*) *fraterna*, Harr., *Serica* spp., and *A.* (*Pachystethus*) *oblivia*, Horn. The last five were of slight importance, but caused at least sufficient injury to be detected by their feeding ; *L. crenulata* was found to have a two-year life-cycle.

By far the most injurious species was *Polyphylla variolosa*, large populations of which are formed in relatively small patches, with the result that seedlings or transplants are often completely eliminated from them. At first these infested patches measure only a few yards in diameter, but they increase in size each year if they are left untreated. There is no major brood of this Melolonthid, and the adults occur in considerable numbers each year ; the larval stage lasts at least three years and probably longer, and all instars are present together. The females are practically flightless, but occasionally fly short distances, and it is supposed that such flights are the source of new infestations. All but 3 of over 6,000 adults taken in light-traps were males.

L. tristis has a two-year life-cycle, with a major brood flying in even-numbered years. The second- and third-instar larvae, which are the most injurious, are most numerous during the summer of the major flight. Hibernation takes place in the third instar, but although pupation does not occur until late in the following summer, very little injury has been observed by the larvae following hibernation.

L. fusca and *L. anxia* apparently have three-year life-cycles, the maximum damage occurring in the year following the major flight. A flight of the major brood occurred in 1935, and the presence of the larvae in 1936 together with those of the major brood of *L. tristis* and normal numbers of the other species present in the nursery caused the greatest concentration of attack by white grubs on nursery stock observed in this area. It is expected that the active instars of the major broods of *L. anxia*, *L. fusca* and *L. tristis* will again coincide in 1942 and each sixth year following.

Larvae of *D. sordida* and *A. lucicola* were both found to cause severe injury, the former destroying several thousand 3-year old transplants of

Norway spruce [*Picea abies*] in 1936. No previous record of the presence of *D. sordida* had been made, except that adults had been observed to feed on the foliage of adjacent transplants of *Pinus sylvestris* in 1934, when most of the area was fallow. The adults did not feed on the foliage of other conifers in the nursery, and under laboratory conditions they refused *Pinus strobus, P. resinosa, Picea abies* and larch (*Larix decidua*), but readily accepted *Pinus sylvestris*. Larvae of *A. lucicola* have not been observed injuring transplants, but caused severe losses in larch seed beds in one year. In addition to immediate losses, many of the surviving seedlings were uprooted by frost in the following winter owing to the injury caused to their root systems.

Characters differentiating the larvae of the species taken are briefly discussed.

EVENDEN (J. C.). **Effects of Defoliation by the Pine Butterfly upon Ponderosa Pine.**—*J. For.* **38** no. 12 pp. 949 955, 5 figs., 7 refs. Washington, D.C., 1940.

Outbreaks of the Pierid, *Neophasia menapia*, Feld., occur at irregular intervals on ponderosa pine [*Pinus ponderosa*] in the north-western United States. The last recorded, which was in central Idaho and was at its peak in 1922 [*cf. R.A.E.*, A **13** 82 ; **15** 79], was responsible for the death of about 25 per cent. of the mature pines over an area of more than 27,000 acres. The defoliation was most severe in 1922, although a considerable amount of damage was done during the previous season. In 1923, the larvae were heavily parasitised and the outbreak rapidly subsided.

The information given in this paper on the effects of defoliation on the trees is based on the results of periodical examinations from 1924 to 1935 of 100 mature pines in a typical stand, of which 84 had been severely, 15 moderately and 1 lightly defoliated. Among the first group, 12 died as the result of defoliation alone, the last succumbing in 1934, and 14 died as the result of defoliation and subsequent attack by the western pine beetle [*Dendroctonus brevicomis*, Lec.] ; no mortality occurred in the other groups. Detailed measurements and analyses of the increment cores showed that reduced basal growth follows defoliation, and that many trees fail to add basal increment during periods ranging in duration from 1 to 11 years. The cores obtained during the last examination in 1935 still showed the effects of the injury.

DOWDEN (P. B.). **Larval Disease prevalent in heavy Infestations of the European Spruce Sawfly in southern New Hampshire and Vermont.** —*J. For.* **38** no. 12 pp. 970–972, 1 fig. Washington, D.C., 1940.

During 1939, large numbers of larvae of *Gilpinia polytoma*, Htg., on spruce in heavily infested areas in southern New Hampshire and Vermont were killed by a disease, the causal organism of which has not been determined. It attacks larvae in the first five instars and is similar in effect to the wilt diseases of other insect larvae. An infected larva rapidly loses its green colour, changing through yellowish green to black, after which it becomes flaccid and soon disintegrates [*cf. R.A.E.*, A **29** 38]. As the body contents ooze out, the skin is frequently stuck to the leaf on which the larva was feeding and may

adhere to it for several weeks after the larva is dead. The disease was occasionally observed in southern New Hampshire and Vermont in 1937 and was common there in 1938. In 1939 it was present throughout the entire infested area, but was most severe in southern New Hampshire and Vermont, where there were dense larval populations.

Observations on the larval population were made in 1939 in a plot where there were on an average about 20 living, hibernating cocoons per square foot in the spring. One tree was banded with an adhesive about 5 feet above the ground in order to record the daily migration of larvae returning to the tree after having fallen from the foliage. About 83,000 first-generation larvae were removed from the trunk between 16th June and 30th July, the maximum on any one day being 8,751 on 4th July. To determine the numbers of living and dead larvae that fell from the foliage, 36 trays a yard square were placed at equidistant intervals in the plot. The larvae prefer the old foliage in the lower two-thirds of the crown, and little larval mortality occurred until most of this had been eaten, but as they subsequently crawled about seeking sufficient food to complete development, large numbers fell to the ground. The disease became prevalent at about the same time, and an average of 110 dead first-generation larvae, most of which had died from the disease, was recovered per square foot. Many larvae completed development, however, and there were on an average 43 living first-generation cocoons per square foot. When the second-generation larvae hatched, there was little green foliage left except on the upper third of the crown and part of the current year's growth on the lower branches. Probably the whole tree was contaminated with the disease organism, as most of the young larvae were diseased. Towards the end of the season scarcely any living larvae remained in the plot, and there were only 6 living cocoons per sq. ft. The deficiency of suitable food doubtless rendered the larvae particularly susceptible to the disease, although there was so little foliage left that probably only a small proportion could have completed development in any case. There was little defoliation by this generation, though had the larvae been healthy they would probably have consumed all the remaining foliage before dying of starvation.

Conditions in the plot were typical of areas in southern New Hampshire and Vermont where feeding by first-generation larvae was heavy, but bordering these areas populations of both first- and second-generation larvae were heavy, and although disease was prevalent in these areas, the larvae had an abundance of suitable foliage and considerable defoliation took place before mortality became pronounced. Many second-generation larvae succumbed to the disease, but a large number completed their development. It is stated in a footnote that the disease was very prevalent in New Hampshire and Vermont in 1940; mortality among first-generation larvae was so high that little feeding resulted in areas where defoliation was expected, and very few second-generation larvae could be found. It is concluded that the disease has been the primary factor in the control of the sawfly in these areas.

It was observed that when larvae were very numerous and many were falling to the ground, large masses congregated at the bases of the trees, and if enough fell from the trunk as they kept trying to ascend, they formed a mass from which they could not escape. The disease apparently killed almost all the larvae in such masses, but it seems probable that the majority would have died in its absence.

Dowden (P. B.) & Sellers (W. F.). **Establishment in the United States of *Microplectron fuscipennis* Zett., a Parasite of the European Spruce Sawfly.**—*J. For.* **38** no. 12 pp. 972–974, 2 refs. Washington, D.C., 1940.

Rearing and liberation of the Eulophid, *Microplectron fuscipenne*, Zett., which was imported into the United States from Ontario for the control of *Gilpinia polytoma*, Htg., on spruce [*cf. R.A.E.*, A **28** 351] was extended in 1939, and more than 200 millions have now been liberated in Maine, and more than 30 millions in New Hampshire, Vermont and New York. Cocoon collections made from time to time indicate that the parasite is widely established ; it has been recovered from 33 townships in New York, 26 in Maine, 8 in New Hampshire, 3 in Vermont, 1 in Massachusetts and 1 in Connecticut. Many of these records are based on small collections of cocoons, but several collections made in 1939 show a significant degree of parasitism. Thus, in a random sample of about 1,500 cocoons from a large number collected in southern New Hampshire in 1939, 9 per cent. were parasitised, but the percentage parasitism in a similar sample from Vermont was only 0·3.

In 1938, 3 colonies of *Microplectron* totalling 30,000 parasites were liberated within a few yards of a study plot in New Hampshire comprising 4 acres of spruce, and 150,000 were released within about a mile of the plot in 1939. A hundred samples of 1 sq. ft. of the surface litter taken throughout the plot in the spring of 1939 contained 8,471 living sawfly cocoons, but there was no indication of parasitism by *M. fuscipenne*. Another 99 similar samples taken in the autumn contained 1,110 living cocoons of *G. polytoma*, about 10 per cent. of which were parasitised. In addition, there were 45 cocoons from which a previous generation of *Microplectron* had emerged in 1939. Ten colonies totalling 100,000 parasites were liberated in 1937 in northern Maine in a pure stand of spruce growing in semi-bog conditions with ground covering of moss. In 1937, when the infestation was heavy, two men collected 500 sound cocoons in an hour, whereas in 1939, when the infestation had decreased noticeably, they collected only 63 cocoons in an hour, of which 5 contained living parasites and 3 dead ones. In a spruce plantation in New York in which larvae of the sawfly have caused noticeable injury since 1937, though living cocoons have been difficult to find, 10,000 parasites were liberated in 1937 and 20,000 in 1939. In May 1939, 50 cocoons were collected, one of which was parasitised, while in November 1939, two men collected 136 cocoons in 6 hours and 18 per cent. were parasitised.

It is concluded that *M. fuscipenne* has become well established throughout the infested area in the United States in a comparatively short time and is increasing at a number of widely separated points. Adults reared from 132 parasitised cocoons collected in the field at 6 different points averaged 38 parasites per cocoon, with 28 per cent. males.

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